A Scranton Gillette Publication

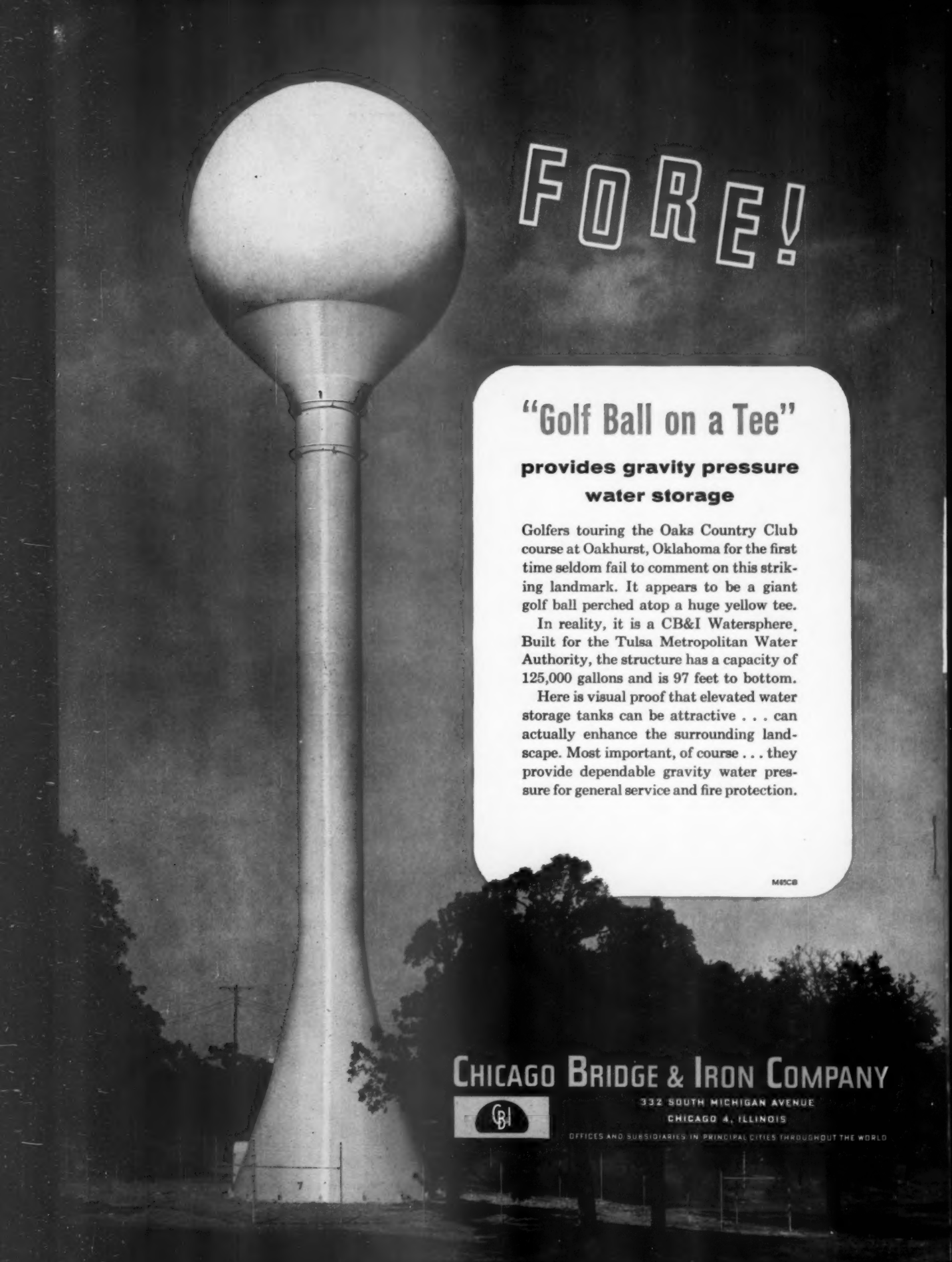
AUGUST 1960

WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL

Qula Reservoir in the Negev Supplies the "Tap In The Desert"

page 293



"Golf Ball on a Tee"

provides gravity pressure water storage

Golfers touring the Oaks Country Club course at Oakhurst, Oklahoma for the first time seldom fail to comment on this striking landmark. It appears to be a giant golf ball perched atop a huge yellow tee.

In reality, it is a CB&I Watersphere. Built for the Tulsa Metropolitan Water Authority, the structure has a capacity of 125,000 gallons and is 97 feet to bottom.

Here is visual proof that elevated water storage tanks can be attractive . . . can actually enhance the surrounding landscape. Most important, of course . . . they provide dependable gravity water pressure for general service and fire protection.

M65CB

CHICAGO BRIDGE & IRON COMPANY

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CHICAGO 4, ILLINOIS

OFFICES AND SUBSIDIARIES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

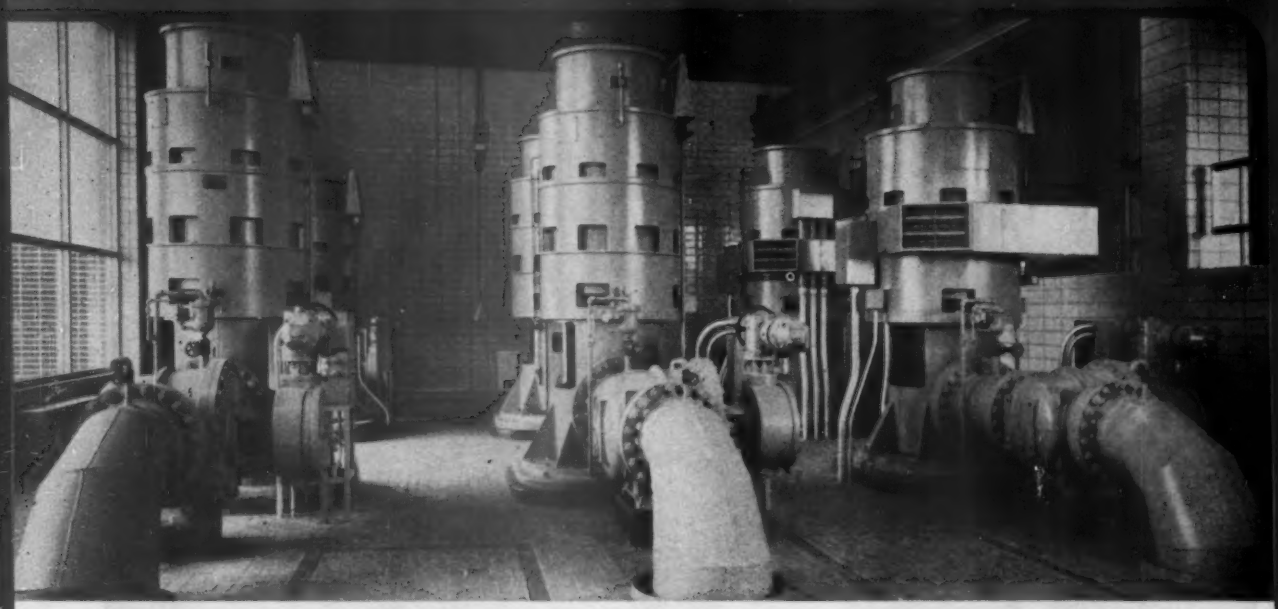
Will your bond-financed sewer system serve for generation after generation, far beyond the date the last bond is paid? Or will it have to be replaced before the bonds are retired.

The surest way to make certain today's dollars are buying generations of dependable service is to specify Clay Pipe . . . *it never wears out.* Clay Pipe does not rust, rot, corrode, or disintegrate. New long lengths with factory-made compression joints make Clay Pipe easier to install and tighter than ever before. Clay Pipe handles ground garbage, detergents, hot liquids, chemicals, acids, anything that empties into the sewer. When you specify Clay Pipe you'll never have to apologize for it or explain any failures. You'll be sure it will still be in service long after the bonds have been retired . . . Only Clay Pipe has *all* the features you can trust!

C-259-4A

Vitrified **CLAY PIPE** *Never Wears Out*

NATIONAL CLAY PIPE MANUFACTURERS, INC. 1820 N Street, N. W., Washington 6, D. C.
311 High Long Bldg., 5 E. Long St., Columbus 15, Ohio • 445 Ninth St., San Francisco 3, California • Box 172, Barrington, Illinois • 1481 Peachtree St., N.E., Atlanta 9, Georgia



PLENTY OF WATER for Springfield-66 MILLION GPD Max.

Springfield, Ohio has a completely new, automatic water supply system by Layne. It guarantees 66 million gallons per day for their present and future needs—a job complete by Layne—and a completely satisfied customer. Field Tests exceeded the guaranteed pump efficiencies by 1% to 2% on all units. Consulting Engineers: Black and Veatch, Kansas City Missouri. Water Supply Contractors: The Layne Ohio Company, Columbus, Ohio. Do you need complete water service? Get it from Layne. Write for Bulletin 100.

Specifications

RAW WATER—10 Layne Gravel Wall Wells with Layne 18-8 Stainless Steel shutter screen and 10 Layne deep well pumps. 2800 GPM — 65 ft. TDH, 75 hp—440 Volts— 1750 RPM, located in two banks pumping to the filter beds. Pumps were installed 15 feet above ground level for flood protection.

FILTERED WATER—Six Layne high service pumps boosting filtered water into distribution system. Five are 12 MGD-285 ft. TDH, 700 hp—4160 volts—1185 RPM. Two are variable speed units. The sixth Layne Pump is a 6 MGD-285 ft. TDH, 400 hp—4160 volts —1185 RPM. All pumps operate through the central control panel.

City of Springfield, Ohio

LAYNE OFFERS COMPLETE WATER SERVICE: Initial Surveys • explorations • recommendations • site selection foundation and soil-sampling • well drilling • well casing and screen • pump design, manufacture and installation construction of water systems • maintenance and service • chemical treatment of water wells • water treatment—all backed by Layne Research. *Layne services do not replace, but coordinate with the services of consulting, plant and city engineers.*

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LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD

Sales Representatives in Major Cities

Vol. 107 No. 8
AUGUST • 1960

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"from Chicago"

The NEW

FLUSH KLEEN® System

COMPLETELY REDESIGNED

. . . to handle modern high solids loadings of wet-strength paper products and ground garbage without clogging or interruption

. . . to operate with smaller pumps and motors.

TWO MAJOR DESIGN IMPROVEMENTS

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. . . permits greater solids loading

2. NEW BY-PASS FITTINGS

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. . . allow greater inflow capacity

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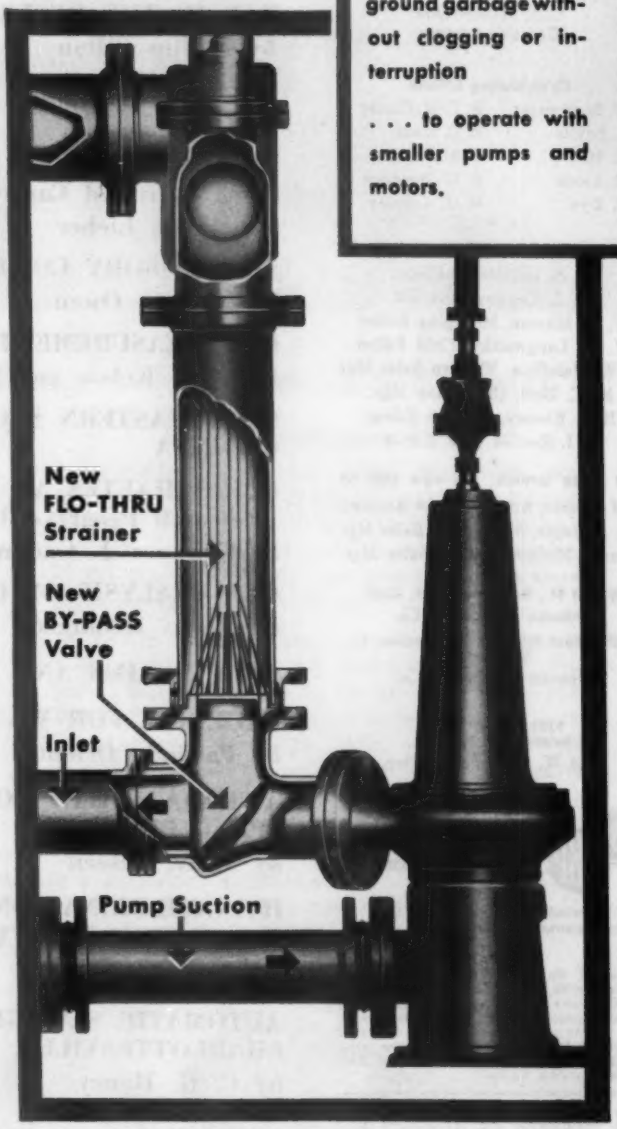

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NEW . . . Successfully handles high wet-strength paper products

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NEW . . . Increases maximum solids loading capacity

NEW . . . Uses smaller pumps and motors

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CHICAGO PUMP
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Briefs

Tap in the Desert tells of Israel's struggle to provide adequate water for its southern rolling area opposite the Sinai Desert—Page 293.

Secondary Sanitary Engineering Conference, Part II, considers the problems of removing radioactivity, regardless of source, from water supplies—Page 296.

Syndet Removal from drinking water, plus foam reduction at wastewater treatment plants, may be practical with dosages of activated carbon—Page 299.

Supervisory Control more efficiently operates the relatively small, but complex water system at Johnstown, Pennsylvania—Page 302.

ORP Measurements in Waste Treatment presents a basic discussion of the theory and application of this determination. The fundamentals of oxidation reduction potentials, methods of measuring the potential as well as an explanation of the two sign conventions used in this work are presented—Page 305.

Southeastern Section A.W.W.A.—Some 368 members and guests met at Savannah, Georgia, and heard an evaluation of the section's water utilities—Page 309.

Oligochaetes as Indicators of Pollution (A Research Progress Report)—A report describing the progress being made toward developing a rapid biological indicator of pollution—Page 311.

Gas Chromatography provides a quick, reliable method for determining the quality of gas produced by sludge digestion processes—Page 312.

The A.W.W.A.'s aims and objectives were outlined at their 80th Annual Conference held at Bal Harbour. Part I of the meeting report includes abstracts of some of the technical papers and discussions presented—Page 314.

Geologic for Water Engineers (by Partially Oriented) presents 21 Theorems definitively interpreting the field of Geology as it relates to Water Engineers—Page 319.

Automatically Controlled Variable Speed Pumping—A saving of $70,000 was accomplished by Denver's North Washington St. Water and Sanitation District when it replaced the original plans and installed a set of variable speed pumps and utilized automatic control sensing of the level of the pump sumps—Page 320.

Hypochlorination of Water is the second of the series, Hypochlorination Guide, which considers hypochlorite-chlorine materials and their use in environmental sanitation control—Page 324.

Editorial—After the Aims and Objectives Committee's report to the membership of the A.W.W.A., it is hoped that actions will replace words—Page 330.

News

Dr. Floyd W. Mohlman Dies

Dr. Floyd W. Mohlman, director of laboratories of the Sanitary District of Chicago for forty years, died May 2, in California. He was a leader in developing the activated sludge process and made many contributions to the advancement of sanitary chemistry and engineering.

Mr. Mohlman had joined the American Chemical Society in 1913 and was chairman of the Division of Water, Sewage, and Sanitation 1924-26. He retired in 1958.

Crowning of Miss Clayland Marks 11th National Clay Week

A chic and talented Dover, Ohio, beauty, Joyce Adair Hinson, was selected "Miss Clayland of 1960."

Miss Hinson, 18, won the crown and a college scholarship from the Clay Sewer Pipe Association of Columbus, Ohio. She also won the right to compete in the "Miss Ohio" finals, preliminary step to competition for the "Miss America" title. The crowning took place during the Eleventh Annual National Clay Week, held recently in Tuscarawas County, Ohio, noted as a clay products center.

Blue-eyed and blonde, Miss Hinson weights 128 pounds and is 5 feet, 5½ inches tall. She won the title over thirteen other entrants and plans to use her scholarship to further her education at Wilmington College, Wilmington, Ohio. Mr. G. A. Robinson, President of the National Clay Pipe Manufacturers, Inc., presented the scholarship award to Miss Hinson at a civic ceremony.

Washington Viewpoint

A U.S. Supreme Court decision concerning depreciation allowances for a manufacturer of clay pipe and tile will have an immediate effect on prices of sewer and water plant construction, it is apparent. And back-up by Congressional action—already approved in the Senate—will reinforce the price rise and may affect other materials as well. The High Court upheld the Internal Revenue Service's contention that a manufacturer of clay products (at Cannelton, Ind.) must take depreciation on the value of the clay as "mined", rather than on the value of the finished product. It'll mean an immediate $50 million windfall for the Treasury—and undoubtedly raise prices to consumers.

☆ ☆ ☆

The decision may also affect other commodities; specifically cement, although cement manufacturers are arguing now that the raw material, unlike clay, has no market value as produced. Therefore, they should be permitted the depreciation on the finished products, as they take it at present. Congressional action, however, backs the Supreme Court's decision. Specifically, it singles out "clay used or sold for use in the manufacture of building or paving brick, drainage and roofing tile, sewer pipe, and....kindred products..."

☆ ☆ ☆

Congress, returning to work this month (August) after its political vacation at Los Angeles and Chicago, has just about as much work in front of it as it had when the session started in January. It shoved through a good bit of "must" legislation—mostly appropriations bills—before it left, of course, but much remains. However, keep one very safe bet in mind: The extra session won't accomplish too much more. If politics was the key factor during the last several months, it will be the overruling factor now. Thus,anything that doesn't promise a real political payoff hasn't a chance. Unfortunately, many of the things that concern Water and Sewage Works people fall in this latter category.

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Of special interest to the field, among the unfinished business that still seems to have a chance, are these matters: The group of bills affecting the minimum wage and other labor concerns, including "common situs" picketing; the Public Works appropriations bill (roughly $1 billion); tax relief for self-employed (via deductions for self-financed retirement plans); amendments to the Federal Water Pollution Act to strengthen the federal government's hand in dealing with the problem.

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The bill to strengthen the pollution control act (S 3574) introduced May 19, is considered to have some chance, becauseit would represent some effort in an area where the President's veto of added federal aid money might be damaging politically. In thumbnail, it would: (1) extend for 5 years, provision of federal grants to state and interstate water pollution control agencies for administration of their programs; (2) make it possible for several communities to put their individual grants together for construction of a single joint facility (this was a provision in the vetoed Blatnik bill); (3) make all interstate navigable waters and coastal waters subject to federal abatement enforcement authority; (4) make discharges from federal installations subject to findings and actions of the Department of Health, Education and Welfare; and, (5) clarify some existing amendments concerning functions of other federal agencies in this field.

The $4.5 billion appropriation bill for the Department of Health, Education and Welfare, also one of the big items on the "unfinished business" list could get hung up—and might invite a veto—because of Senate amendments that added $463.9 million to the amount requested in President Eisenhower's budget. Biggest share of the increase would go to the Public Health Service ($281 million) to be used for construction and other work of the National Institutes of Health, to construction grants for hospitals, nursing homes and other facilities and the like. It also contains $211 million for hospital construction under the Hill-Burton program, an $85 million jump above budget requests.

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Still another item on the unfinished list is a Senate bill (S 3549) aimed specifically to aid manufacturers, but of interest to engineers and others who do business in states other than their own. The bill would prohibit use taxes on out-of-state businesses so long as the only activity in the "foreign" state is solicitation of business or orders which will be filled in another state.

Growing federal interest in whether modification programs was evidenced by appointment of a well-known scientist to head up a national center of atmospheric research under sponsorship of the National Science Foundation. The center is to be located at the High Altitude Observatory at Boulder, Colo. First job for Walter Orr Roberts, newly-named director, will be to determine feasibility of selected research projects, and start research on applying basic science and engineering techniques to atmospheric research.

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Sanitary engineers, who reacted strongly to a bill introduced last year under the title of "Health Educational Facilities Construction Act", has a partial answer to their complaints that this act (HR 6906) ignored the sanitary engineering aspects of environment health. The answer was embodied in a bill (S 3680) introduced by Senator Jacob Javits of New York for the HEW department. It would include construction grants for teaching facilities for health sciences, plus grants for "graduate training in public health", including schools of engineering. Neither measure, however, is rated likely to come up for action this session.

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Also still in the mill—and rated a good chance for approval—is a measure to expand the current Saline Water conversion program, increase loans for construction of such plants, and expansion of investigations. It has the powerful backing of Senate Majority Leader Lyndon Johnson.

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On local matters, Congress finally approved a bill to construct a $28 million interceptor sewer line from the new Dulles International Airport at Chantilly, Va., to the District of Columbia's existing Blue Plains disposal plant. The line will be tapped by Virginia and Maryland communities along its route, and eventually will be turned over to these communities—or some overall agency—for operation. And, to the accompaniment of cannon shots and a spouting fireboat, the District began work on its "project C"—first step in a program to replace present combined sanitary and stormwater sewers with separate systems.

☆ ☆ ☆

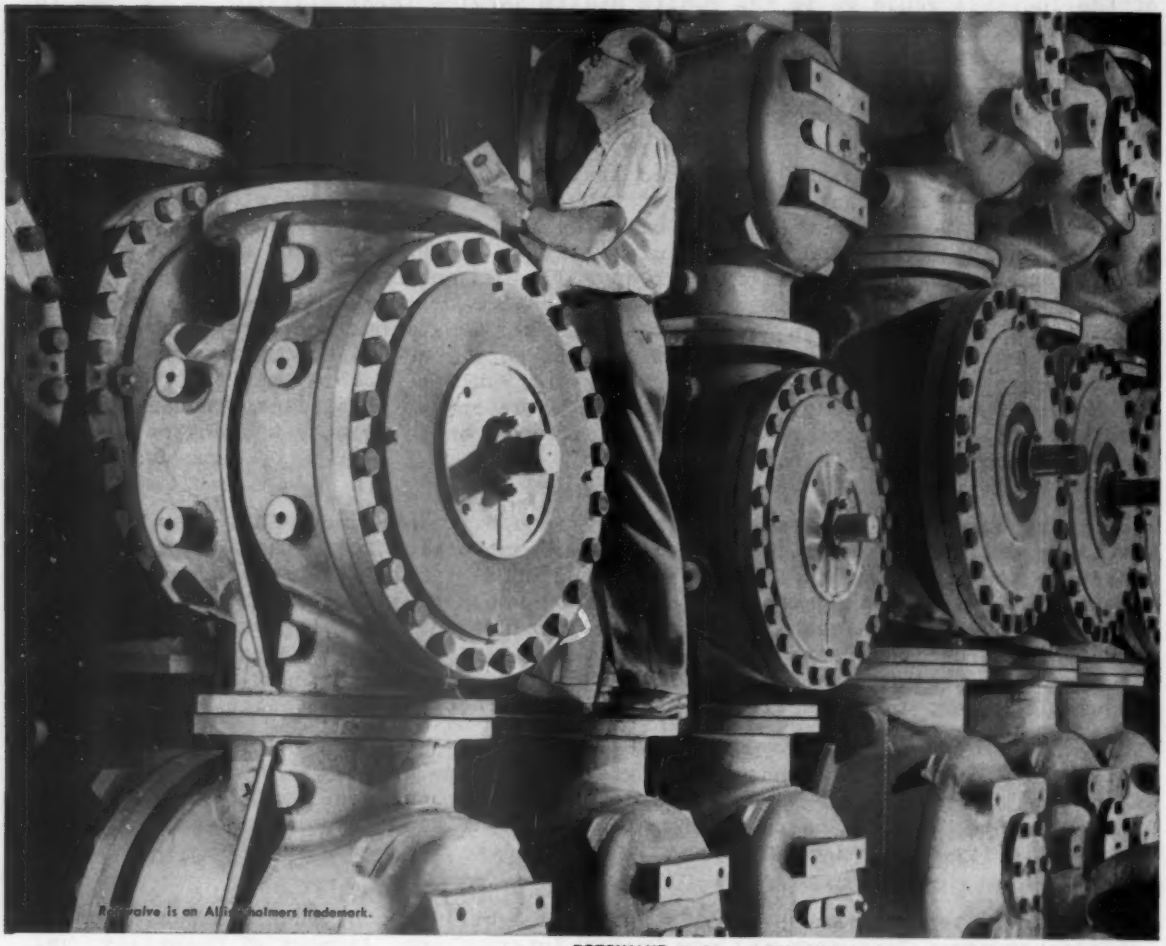
Engineering societies were successful in a last-minute effort to block legislation that would have required bidding for professional services in Armed Services procurement activities. The societies protested highly technical and obscure amendments to procurement acts that would have put professional services on a price level, vertually eliminated negotiation. House committeemen hastily removed the objectionable passages from the bill (HR 12752).

☆ ☆ ☆

The Atomic Energy Commission—despite recent findings (see July column) that ocean disposal areas for radioactive wastes so far have been safe—wants to be very careful in the future. For that reason, AEC refused to grant a portion of a license to the Industrial Waste Disposal Corp., of Houston, Texas, which would have permitted the organization to use sea disposal for radioactive wastes from hospitals, research facilities and industry. Instead, AEC sent the application back to a hearing examiner for "further proceedings concerning the integrity of waste containers after disposal at sea."

ALLIS-CHALMERS

A-1260



ROTOVALVE stocks at A-C York Works save months of delay for customers.

Another Allis-Chalmers time-saving exclusive:

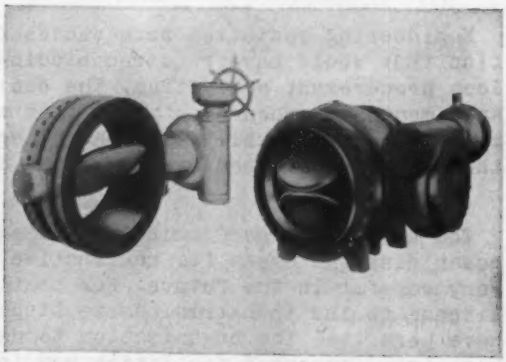
Cone valves "right off the shelf!"

Six to thirty-inch *Rotovalve* units — awaiting your call. Think of the valuable time you save! Typical is the case of a western municipality that recently needed one 24-inch and three 20-inch *Rotovalve* units for their waterworks. Allis-Chalmers assembled all accessories required, completed testing and shipped the valves to customer in less than three weeks! Compare this with the 3 to 6 months normally required by other suppliers for delivery.

Perpetual off-the-shelf inventory of *Rotovalve* units, butterfly and ball valves gives Allis-Chalmers today's only complete rotary valve-stocking program . . . guarantees fastest deliveries to you.

Avoid troublesome, costly delays and get the valves you need to do the job right. For immediate assistance anytime, call your nearby A-C valve representative, district office or write **Allis-Chalmers,** Hydraulic Division, York, Pa.

Rotovalve is an Allis-Chalmers trademark.



Standard butterfly and ball valves illustrated are also available from stock in a broad range of sizes.

Equipment News

Trencher Features Automatic Shifting and Tilting

801

The Cleveland Trencher Co., Cleveland, Ohio, is offering the JS-30, which features instant lateral positioning and tilting of its digging wheel, and which digs trench behind either a crawler or at any point within its 6-foot width. The trencher also cuts verticle trench on side slopes and in similar conditions where one crawler track is on a higher level than the other, thus eliminating the need for blocking and cribbing.

Lateral shifting of the digging wheel enables the unit to dig the edge of a 24-inch wide trench 5 inches outside either track, permitting trench to be dug flush with paralled pavement, curbs and sidewalks. It also excavates short runs of extra-wide trench and bellholes, to a 6-foot maximum width without lateral repositioning of its crawler.

Hydraulic power-tilting of the digging wheel 7 degrees to either side of vertical (a total tilting range of 14 degrees) enables the JS-30 to dig vertical trench on side slopes and next to curbing, without crubbing. Power tilt adds 7 inches to the outside cut of the digging wheel, and combined with lateral shift, permits digging trench virtually flush with fences, walls, trees, poles and other above-ground obstructions.

The power-shift and power-tilt design of this trencher's digging wheel is especially valuable in cutting trench to extra widths required at pipe joints. The unit's standard trench capacity is from 11 to 24 inches wide, down to 5½ feet deep.

A new V-shaped conveyor permits high and farther spoil discharge and higher heaped loads on the conveyor belt. It is driven, shifted and reversed by dual independent hydraulic drives contained within the conveyor. Automatic conveyor positioning permits the operator to place spoil where required; all operations are lever-controlled at the operator's seat.

A 370 cubic inch diesel engine develops 56 HP at only 1250 RPM, drives through main transmission to the digging wheel differential. The operator has a choice of four wheel speeds and 12 individual crawler speeds, providing a combination of over 30 usable, positive wheel and crawler speeds for every digging condition and job situation.

Water Reducing Valve Line Extended

802

Leslie Company, Lyndhurst, N. J., announces the broadening of its Hi-Flo line of liquid pressure reducing valves to meet the need for closer control of water consumption due to both shortages and rising water cos's.

The new valve classes WLK, WK, WHK, WL-2, W-2, WH-2, WLB, WB and WHB are suited to meet a wide variety of water and other liquid pressure reduction applications. They are designed for inlet pressures from 10-300 psi and temperatures up to 180°F. The choice of wide reduced pressure ranges available covers pressures from 5-100 psi.

Some of the construction features of the new Leslie Hi-Flo Valves include large bowl construction and long travel diaphragm giving full flow; fully balanced operation for smooth throttling action and stable control; tight shutoff, fully guided main valve and renewable trim with interchangeable fit.

Leslie Hi-Flo Valves are available with screwed or flanged ends in cast iron or bronze bodies. Complete sizes range from ½" to 2".

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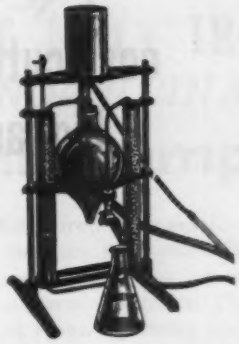
ENSLOW

STABILITY INDICATOR



For checking the equilibrium of a finished water, and supplying an index useful in controlling anti-corrosion treatment. Catalog No. 83-895

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Phipps & Bird, Inc.

P. O. Box 2V Richmond 5, Va.

the nameplate of dependability...

MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

Badger *Read-o-Matic's** cost-cutting story is big as all outdoors

*Pat. applied for in U.S.A. and foreign countries.

All over the country water departments are cutting meter-reading costs and increasing efficiency with Badger Read-o-Matic outdoor meter-registers.

Accessibility is the big advantage of this self-contained register. Read-o-Matics are installed *outside*, often in convenient "reading stations" which a meterman can read quickly and easily. This system is safer, too, because it completely eliminates the dangers involved in climbing down into underground vaults and other inconvenient locations.

Install this faster, lower-cost reading system in your water department. Write for literature or call your Badger representative for a demonstration.

Badger Meter Mfg. Co.

4545 W. Brown Deer Rd.
Milwaukee 23, Wisconsin

12-60

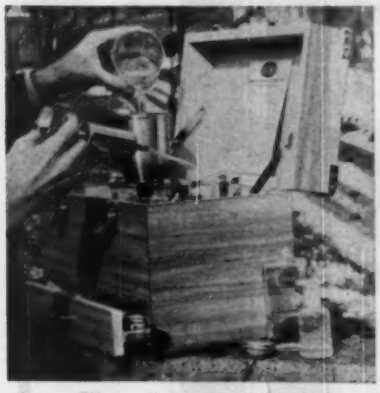
Equipment News

CONTINUED FROM PAGE 9A

Portable Unit for Field Testing Water

803

General Ionics Corp., Pittsburgh, Pa., has developed a portable laboratory unit designed to measure the bacteria content of drinking water and to process water in industrial



plants. The unit is especially designed for field-testing water and, therefore, is constructed for durability, abrasion resistance and the ability to withstand bumps and other hard useage.

The unit's finish is made of Micarta decorative plastic laminate manufactured by the Westinghouse Electric Corp., of Hampton, S. C., which was found to be the most suitable for the tester's purpose.

In the lower portion of the case an incubation chamber, designed for thermostatically-controlled electric heating, used for the necessary growth of latent bacteria in the tested water. This arrangement permits tests to be made at the point of inspection rather than in the laboratory. The top portion of the unit is fitted with filters, filter holders, a vacuum pump, culture containers, alcohol, distilled water, and necessary glassware and chemicals.

The bacteriological determination is made by the recently-developed and accepted membrane filter technique.

Multi-Purpose Pressure Gage

804

Helicoid Gage Division, American Chain & Cable Co., Inc., Bridgeport,

CONTINUED ON PAGE 17A

Another Important FIRST By "VERTI-LINE" PUMPS...

HIGH-TEST "MOLY" IRON NOW "STANDARD" IN ALL Verti-Line Pumps

Again Layne & Bowler sets new standards of quality construction for the pump industry... *longer-life Molybdenum-Iron is now "standard" construction — at no extra cost — in* ALL *"Verti-Line" pump cases and other cast iron parts!*

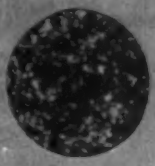
"Moly" iron has a more uniform grain structure, is far more corrosion-resistant than is the gray iron normally used in pump construction. Therefore, you get longer operating life, lower maintenance costs, when you specify Layne & Bowler "Verti-Line" Pumps!

COMPARE!

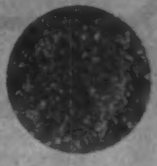
GREY IRON

MOLY IRON

▶ **These Photomicrographs,** both made at exactly the same enlargement (100x), show the structure of gray iron (left) vs. "Moly" iron (right). Note the long "stringers" of soft graphite characteristic of gray iron — stringers that weaken the metal and lead to early breakdown of the iron matrix. Note (right) how "Moly" iron is far more homogeneous, with uniform distribution of the iron matrix for longer pump life.



GREY IRON



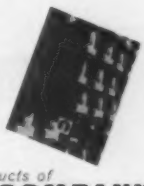
MOLY IRON

▶ **These "Fractures"** (views across fractured surfaces) clearly show the much coarser grain of gray iron (left) vs. the uniformly fine grain of "Moly" iron (right.) Although Layne & Bowler's fine-grained "Moly" iron assures much longer pump life than the gray iron used in other pumps, *you now pay nothing extra for this important "Verti-Line" advantage!*

Layne & Bowler has its own modern foundry—therefore can standardize its foundry runs to "Moly" iron techniques *at no extra cost to you.*

And if your operations are extra tough, "Verti-Line" pumps are available in special "Moly" irons having a Brinell as high as 350... a Tensile as high as 80,000 psi!

Remember—"Moly" iron is just one of many major pump advancements built into every "Verti-Line" pump—advancements that assure top performance for your pump dollar when you specify "Verti-Line" Pumps!



For more details on the many "Verti-Line" advantages, write for Bulletin #200.

Verti-Line Pumps are exclusive products of

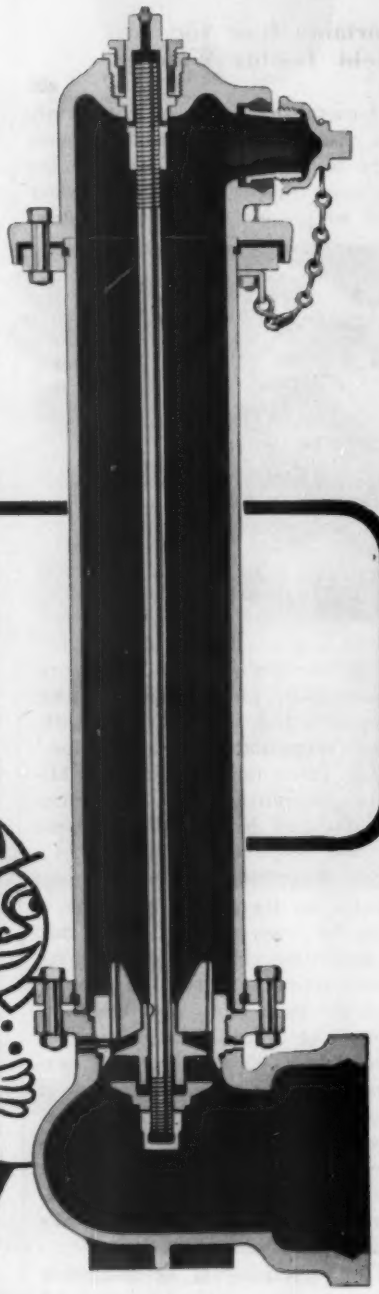
LAYNE & BOWLER PUMP COMPANY

LOS ANGELES 22

New York 20, N.Y. • Chicago 4, Ill. • Hastings, Neb. • Monroe, La. Farwell, Texas • Twin Falls, Idaho • Fresno, Calif.

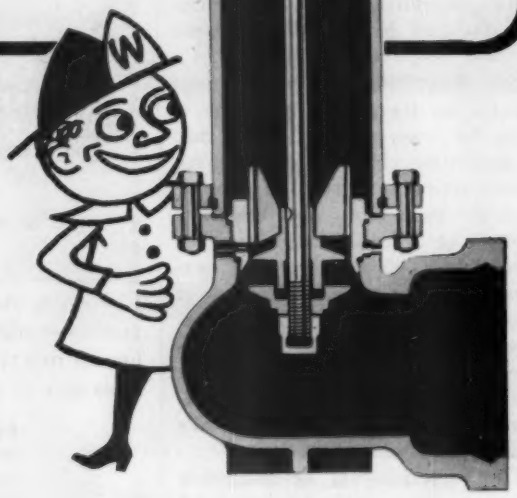
THE R. D. WOOD HYDRANT

The R. D. Wood Hydrant is simple in design, yet offers all the features needed for the utmost reliability. Your community would have to look a long time before it would find another hydrant so serviceable and rugged. For full neighborhood protection at minimum outlay, look first at R. D. Wood Hydrants.



BRONZE PARTS

Every point of friction is protected by at least one bronze surface. This assures against rust and interference with operation. The stuffing box, gland and operating nut are *all bronze*—corrosion-proof!



AND THESE FEATURES, TOO:

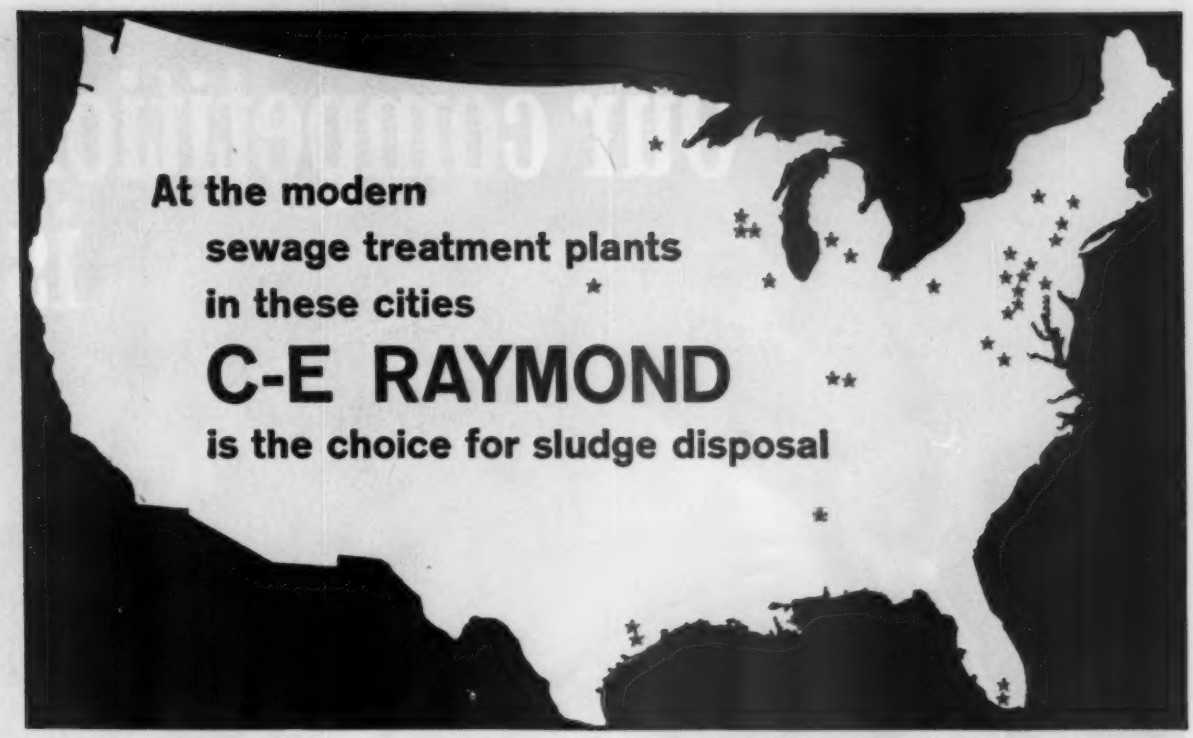
Valve opens against water pressure, remains closed in case of accident. Head revolves 360°. Optional break-point flange and breakable stem coupling permit quick repair without excavating. Optional extension piece can be inserted without shutting off water. Available with bell, mechanical joint or flange pipe connections; conventional or "O" ring packings.

Conform to latest AWWA specifications

R. D. WOOD COMPANY

Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Manufacturers also of Mathews Modernized Hydrants, Mathews Flange Barrel Hydrants, R. D. Wood Gate Valves, and "Sand-Spun" Pipe (centrifugally cast in sand molds)



Here are some reasons why the C-E Raymond Flash Drying and Incineration System has been selected by treatment plants throughout the country . . .

Flexible – It reduces filter cake to non-lumpy particles of uniform low moisture content without scorching . . . a product very suitable for use as soil conditioner . . . or if sludge characteristics render it unfit for this use, quickly incinerates it to a sterile ash. It is available with high temperature deodorization and fly ash collection.

Efficient – It assures built-in plus-performance for effective and controlled drying of filter cake with high *thermal* efficiency. This means less fuel cost penalty when incinerating low heat-content sludges since design thermal efficiency can be consistently maintained.

Advanced – It incorporates small groups of arch bricks individually hung from steel supports rather than relying upon self-supporting refractory arches. This requires little maintenance, makes arch failure virtually impossible, and permits rapid start-ups . . . less than 30 minutes for furnaces capable of burning in excess of 120 tons of filter cake daily. It has the most fully automatic controls for drying and furnace operation of any system available.

Proven – It is the most widely used method for heat disposal of sewage sludge. More filter cake is dried and/or incinerated in the C-E Raymond System than in all other systems combined.

For further details contact the Combustion Engineering office nearest you. Our engineers will be happy to discuss, with you or your consultants, how this system can benefit your community.

★ **Communities in the United States which have selected C-E Raymond for sewage sludge disposal**

Baltimore, Md.
Bethlehem, Pa.
Bloomsburg, Pa.
Buffalo, N. Y.
Camden, N. J.
Chicago, Ill.
Coral Gables, Fla.
Cuyahoga Falls, Ohio
Duluth, Minn.
Fond du Lac, Wisc.
Galveston, Texas
Harrisburg, Pa.
Houston, Texas
Jefferson Co., Ala.
Lansing, Mich.
Los Angeles, Calif.
Louisville, Ky.
Lynchburg, Va.
Miami, Fla.
Neenah-Menasha, Wisc.
New Albany, Ind.
New Rochelle, N. Y.
Omaha, Neb.
Petersburg, Va.
Pittsburgh, Pa.
San Diego, Calif.
San Francisco, Calif.
Schenectady, N. Y.
Sheboygan, Wisc.
Springfield, Mass.
Warren, Mich.
Washington, D. C.
Waterbury, Conn.
Wyomissing Valley, Pa.
York, Pa.

COMBUSTION ENGINEERING

RAYMOND DIVISION

C-E

C-2118

1132 West Blackhawk Street, Chicago 22, Illinois

Eastern Office: 200 Madison Avenue, New York 16, N. Y. • Western Office: 510 West Sixth Street, Los Angeles 14, Calif.

Canada: Combustion Engineering-Superheater Ltd.

ALSO FLASH DRYING AND INCINERATION FOR INDUSTRIAL WASTE DISPOSAL

Our competition
is

flattering us...

The greatest compliment an advertiser can receive is when his competitors imitate his campaign.

That's why we at the Cast Iron Pipe Research Association feel so proud.

For 30 years we have been telling the public about the water problem.

We were the first to come out with consumer national advertising on this problem.

We were the first to inform the people of the need for action at the community level.

We were the first to furnish materials for local advertising programs.

We were the first to offer a comprehensive community relations plan with all necessary materials.

We were the first to issue a guide-to-action booklet which would serve as a step-by-step manual for responsible citizens.

We have been fighting the nation's water problem for over a generation.

And now other pipe companies are coming out with water campaigns, too.

Thank you, competition.

We're flattered.

CAST IRON PIPE

THE MARK OF THE 100-YEAR PIPE

CAST IRON PIPE RESEARCH ASSOCIATION,
Thos. F. Wolfe, Managing Director,
3440 Prudential Plaza, Chicago 1, Illinois

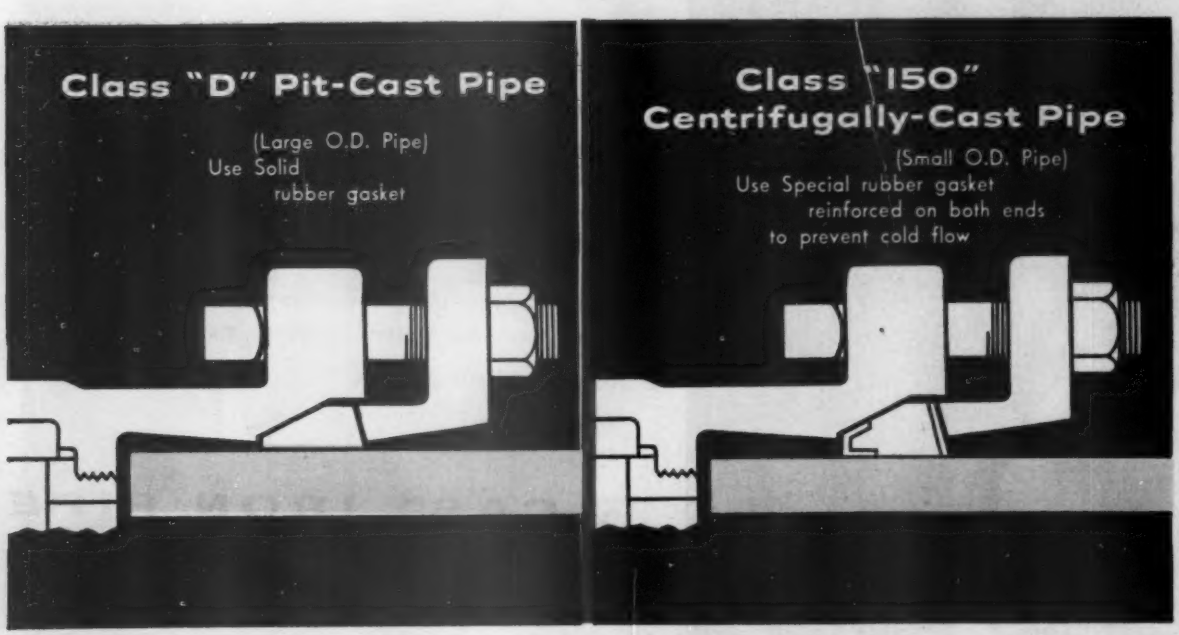
NEW! MUELLER® D-150 MECHANICAL JOINT*

. . . fits all classes of cast iron pipe regularly used!

Now, a single mechanical joint connection can be used with any class of pipe from Class "D" pit-cast pipe to Class "150" centrifugally-cast pipe just by selecting the proper gasket. Only two are needed.

These two gaskets, each accurately sized to the class of pipe, make installations faster, simpler and cheaper. The joints last longer, too, because the accurate fit prevents cold flow and future leaks.

Write for complete information and specifications.


Class "D" Pit-Cast Pipe
(Large O.D. Pipe)
Use Solid rubber gasket
Class "150" Centrifugally-Cast Pipe
(Small O.D. Pipe)
Use Special rubber gasket reinforced on both ends to prevent cold flow

* Now available on Mueller AWWA Improved Fire Hydrants and AWWA Gate Valves. Stock just one type of hydrant or valve for replacement installations in either the new or older sections of your system.

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles; In Canada: Mueller, Limited, Sarnia, Ontario.

Equipment News

CONTINUED FROM PAGE 11A

Conn. has designated as the Gearcoid Gage Type 110, a new, heavy-duty, geared-movement pressure gage designed for a wide range of applications, such as water, steam, gas, oils or any other media not corrosive to brass or bronze.

The integral design of the socket, tube, tip movement, pointer and dial assembly permits installation by hand-turning the gage case; this eliminating inaccuracies in pressure readings resulting from any distortion of piping. Rugged, dependable service is assured by utilization of a heavy-duty drawn steel case, a friction type snap-on ring that is beaded for lens protection and a double-gasketed lens.

All system assemblies, socket, tube and tip are carefully tested for tip travel, overpressure, leak-tested and stress relieved prior to final gage assembly.

Featuring heavy-duty glass, shatterproof or plastic being optional, both sides are protected against-shock by two weather-resistant gaskets. Its tip is butt brazed and style-notched for rigidity. The gage's 4½" dial, with its white background and black lithographed figures for utmost readability, is mounted directly on the movement.

Made in 20 different standard ranges of 0-15; 0-30-0-60-, 0-100; 0-160; 0-200; 0-300; 0-400; 0-500; 0-600; 0-800 nd 0-1000 psi.; compound ranges of 15/30", 30/30", 60/30", 100/30", 150/30", 200/30" VAC. VAC., all standard ranges are stocked for immediate shipment. and in a vacuum range of 30"-OX

The Gearcoid Gage can be connected into the pressure line through a ¼" N.P.T. bottom connection. Accuracy is in accordance with standard A.S.A. Grade "A" specifications. Net weight is 1 lb., 13 oz.

Transistor Pipe Detector

805

Computer Measurements Company, Sylmar, California, has announced production of its new transistor pipe detector, the Detectron Model 808 which incorporates circuitry specifically designed to utilize transistors to their fullest advantages.

Inadequacies usually inherent in transistors, such as heat limitations, have been eliminated by the use of special compensating circuitry. Thus, the 808 is suitable for use in hot southern climates where the heat instability of transistors has previously been a problem.

In the many applications of a pipe detector, the principal feature of the 808, in contrast to tube instruments, is in the tracing of pipes and cables by the conductive method. This is of a particular advantage in areas where highly mineralized soil is the problem, or where there are many abandoned pipe lines. The cut-off of the 808 is sharp, thus assuring separate detection of pipe lines lying close together.

The 808 is designed not only to detect and trace pipes, cables, and conduits, but also to locate valve boxes,

CONTINUED ON PAGE 21A

The Superior Coagulant With Many Plus Features

Excellent Taste and Odor Control—Increased Filter Runs—Coagulation Over Wide pH Range—Rapid Floc Formation—Turbidity Removal—Manganese and Silical Removal—Bacteria Removal—Efficient and Economical—Ease of Operation and Handling.

WATER TREATMENT

Efficient Coagulation of Surface or Well Water—Effective in lime-soda ash softening—Adaptable in treatment of all industrial applications.

SEWAGE TREATMENT

Coagulates over wide pH range and provides efficient operation regardless of rapid variations of raw sewage—Very effective for conditioning sludge prior to vacuum filtration or drying on beds.

SODIUM SILICOFLUORIDE

For Fluoridation of Municipal Water Supplies—Available for prompt shipment—Inquiries invited.

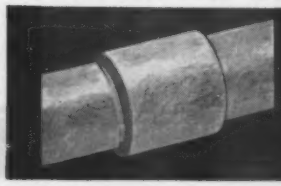
For complete list of our products see our inserts in Chemical Week Buyers' Guide, Pages 173-176 or Chemical Materials Catalog, Pages 551-554.

For more detailed information make request on your firm's letterhead.

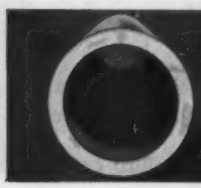
TC TENNESSEE CORPORATION
612-629 Grant Building, Atlanta 3, Georgia

you don't need an "eye"

Keasbey & Matti



Exclusive, patented "K&M" FLUID TITE Coupling forms a permanent leakproof seal as pipe is joined.



Permanently smooth bore keeps pumping costs low. Provides excellent flow characteristics.

"K&M" Asbestos-Cement Sewer Pipe helps you provide the best sewer service available . . . with tax savings that go on year after year.

This thrifty pipe is infiltration-proof, even when external water pressure is 25 psi. Prevents your sewer system from reaching full capacity years ahead of schedule, due to water infiltration. "K&M" Asbestos-Cement Sewer Pipe, with exclusive, patented FLUID-TITE Coupling, forms a permanently tight seal.

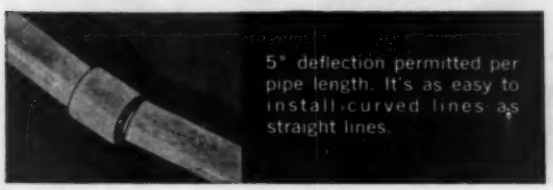
In planning your system, you can build on flatter grades with "K&M" Asbestos-Cement Sewer Pipe. Need fewer lift stations. The permanently smooth bore of "K&M" Asbestos-Cement Sewer Pipe has a Manning factor of n=0.010. Flow characteristics are excellent. Inspections and treatment loads become less frequent.

This thriftiness carries over into installation. Neither weather nor soil conditions need hold up work. The "K&M" FLUID-TITE Coupling slides on in just two easy steps. Longer pipe lengths minimize the number of joints.

Write today for more detailed and illustrated information on hardy "K&M" Asbestos-Cement Sewer Pipe. Learn why thousands of progressive communities have turned to this durable quality pipe. Write to: Keasbey & Mattison Company, Ambler, Pa., Dept. P-980.

son at Ambler

K·M BEST IN ASBESTOS



"K&M" PLASTIC SEWER PIPE complements "K&M" Asbestos-Cement Sewer Pipe in many sewer systems. Excellent flow characteristics and permanently tight joints. Write for Technical Bulletins on "K&M" High-Impact Styrene-Alloy Sewer Pipe. Dept.

95% SPACE SAVINGS for sewage plants

COMPARATIVE SPACE REQUIREMENTS
(Based on data in FISWA Manual of Practice No. 8, 1959)

Population	Average area for open sand beds (square feet)	Average area for complete vacuum filter installation (square feet)
10,000	17,500	950
20,000	35,000	1,400
30,000	52,000	1,900
40,000	70,000	2,250
50,000	87,500	2,650
100,000	175,000	3,500

Vacuum filters using Pennsalt Ferric Chloride to get faster coagulation—and denser, drier filter cake—require as little as 5% of the area of open sand beds. And labor costs are lower . . . odor problems eliminated . . . peak loads more readily handled.

Plan to use this modern method of filtration in your new plant. We will be glad to share with you and your consulting engineers our 30 years of experience with ferric chloride. Write Industrial Chemicals Division, PENNSALT CHEMICALS CORPORATION, Three Penn Center, Philadelphia 2, Pa.

For dependable water treatment, use Pennsalt Water Works Grade Chlorine.

See our complete listing in Chemical Materials Catalog

Industrial Chemicals Division

SALES OFFICES: ATLANTA • CHICAGO • DETROIT • NEW YORK
PHILADELPHIA • PITTSBURGH • ST. LOUIS • APPLETON
TACOMA • PORTLAND

INDUSTRIAL QUÍMICA PENNSALT, MEXICO CITY

Pennsalt Chemicals
ESTABLISHED 1850

Equipment News

CONTINUED FROM PAGE 17A

service, studs and miscellaneous metallic objects. The depth of a pipe or cable can usually be quickly estimated by triangulation. Also, if necessary, a pipeline can be located so precisely that it can be marked on the pavement above within an area narrower than the width of the pipe itself. Depth range on one inch water pipes approximates 10 feet, and maximum depth range of the instrument on large lines is 20 to 25 feet depending upon soil conditions.

The detector uses standard batteries which require replacement on the average about once a year.

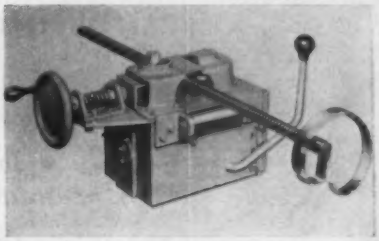
Variable Speed Sewer Cleaning Machine

806

The O'Brien Manufacturing Corporation, Chicago, Illinois, has announced an improved power transmission unit provided with their Sewerking cable-type, all-power sewer cleaners. This patented gearing unit grips the threaded steel cleaning cable which passes through it, to send the cable into the sewer or pull it back by a simple shift of the transmission lever.

The new OB Power Transmission now allows the cable basket to turn at a constant RPH, but permits the speed of the cable into the sewer to basket RPM, the new transmission be varied. Thus, without changing provides just the right cutting speed as is required by the severity of the stoppage.

Another highly important improvement of O'Brien Sewerkings is the positive hydraulic braking system. This is capable of stopping the cable and basket instantaneously, an important safety factor for the operator and providing protection for the equipment.



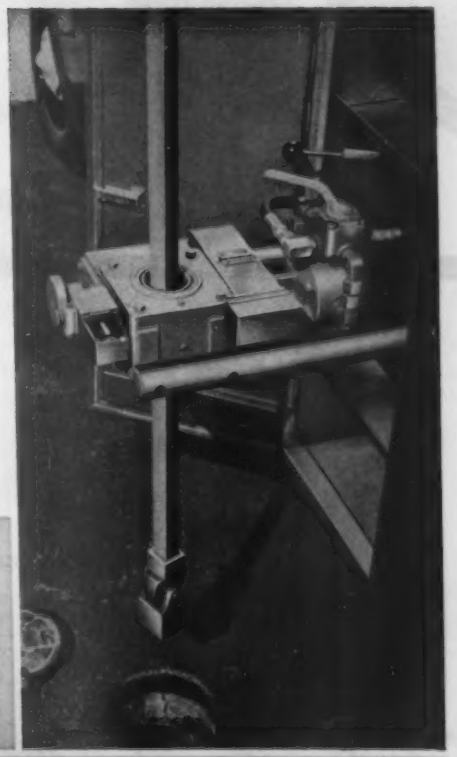
Sealed Metal Meter Box

807

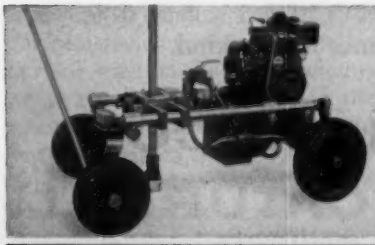
Buffalo Meter Company Inc., Buffalo, N. Y., has announced an improved sealed metal register box for their 5/8" x 3/4" and 5/8" x 1/2" "American" Water Meters. It is offered as optional equipment, at small extra cost, and is interchangeable with the sealed plastic register box.

CONTINUED ON PAGE 76A

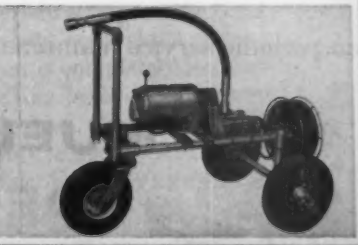
HYDRAULIC TRUCK MOUNTED VALVE OPERATORS PROVIDE ONE MAN CONTROL OF VALVES FROM 10" TO 60" SHIPPED FULLY ASSEMBLED, FOR MOUNTING IN ANY MAKE OF TRUCK BY YOUR OWN MECHANICS, WITHIN A FEW HOURS. HAS SAFETY DEVICE FOR DAMAGE PROTECTION ALSO POSITION INDICATOR.



PORTABLE 3-10 HP.



ELECTRIC DRIVE

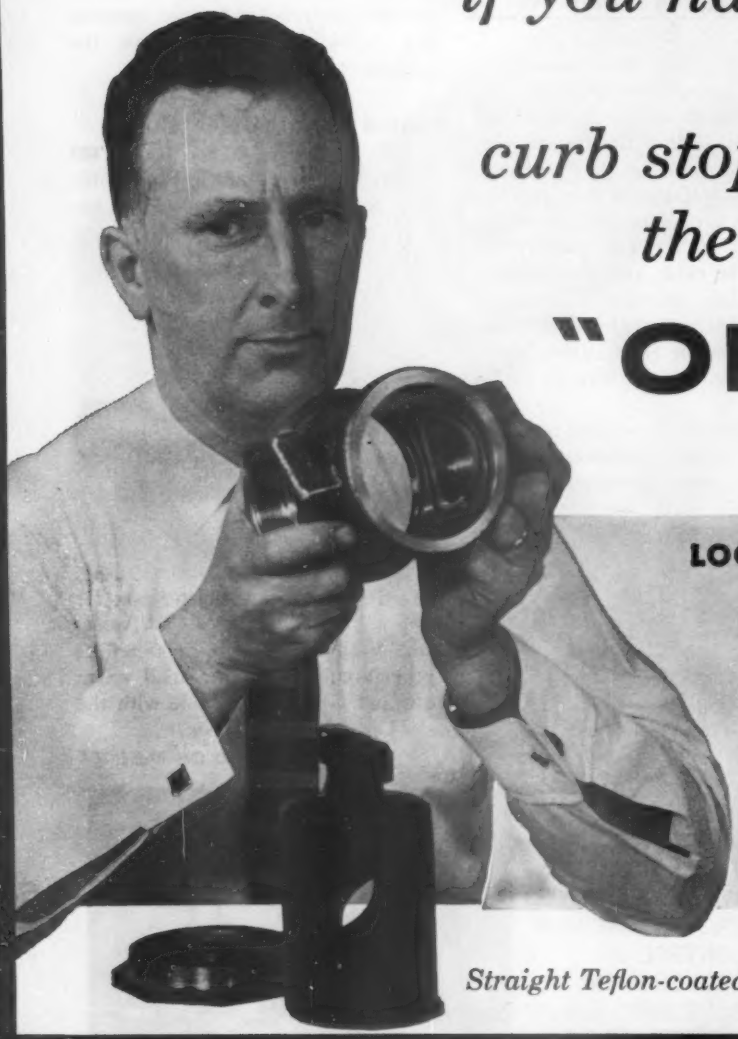


Makes EVERY VALVE Power Operated.

Payne Dean & Co.
Clinton, Conn.

if you have problems with "sticking" curb stops, look into the new Mueller®

"ORISEAL®"



LOOK INTO THE IDEAL CURB VALVE

- *Investigate the easy turning design features*
- *Investigate the long-life operating dependability*
- *Investigate the many reasons behind its amazing performance record.*

Straight Teflon-coated plug . . . "O" rings in the body

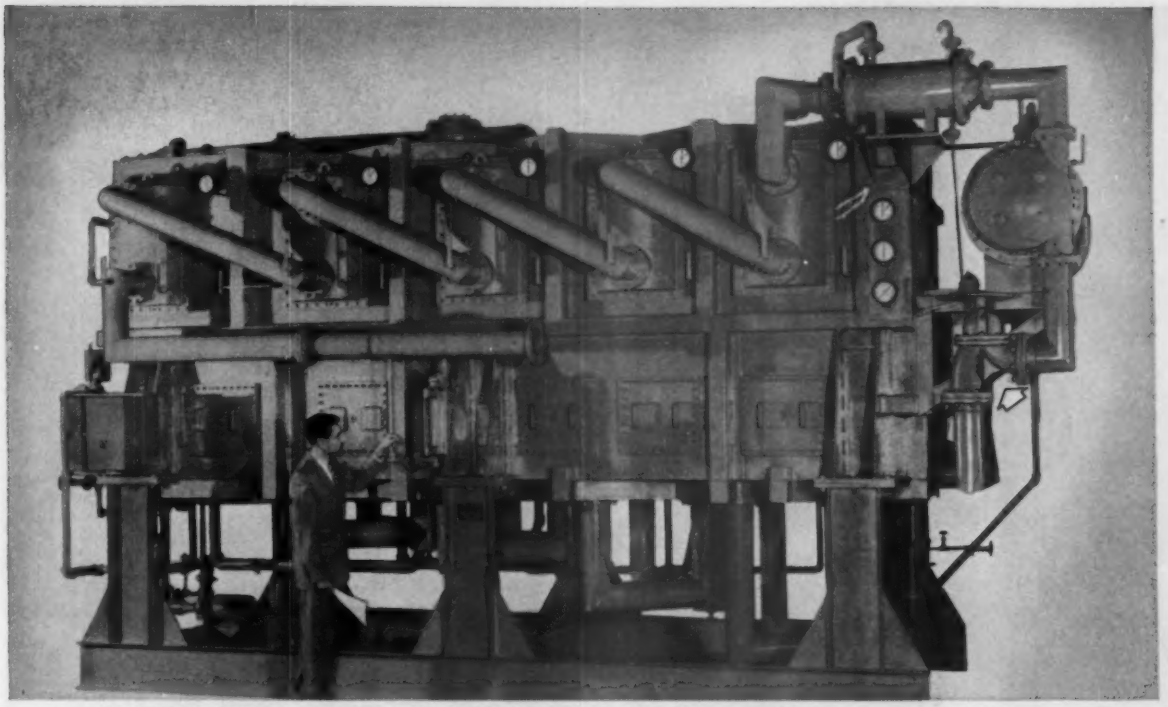
■ Twelve years of intensive field testing have proved the big advantages in the Oriseal's simple, sturdy design. After 25,000 to 45,000 cycling operations, this curb valve remained leakproof, remained easy to turn and had required no periodic service maintenance of any kind.

See your Mueller representative or write today for complete Oriseal test information. If you have experienced "sticking" curb stops, test an Oriseal Curb Valve in your water system and prove its many operating advantages.

MUELLER CO. Since 1857 SERVING the Water and Gas Industries QUALITY

MUELLER CO.,
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles;
In Canada: Mueller, Limited, Sarnia, Ontario.



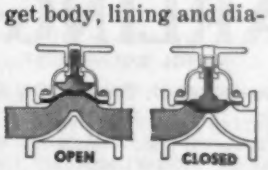
ON LAND At Salinas, a tourist center in Ecuador, this Cleaver-Brooks Flash Evaporator delivers 50,000 gallons of pure, distilled water every 24 hours. It is equipped with two 6", rubber lined, weir-type Grinnell-Saunders Diaphragm Valves — only one of which can be seen from this view.

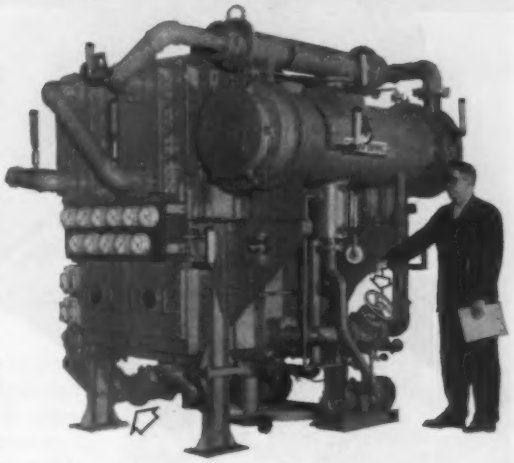
Grinnell-Saunders Diaphragm Valves help convert salt water to fresh water

You can convert sea water to fresh water, in abundant supply, on land . . . or on shipboard, with flash evaporators made by Cleaver-Brooks Special Products, Inc., Waukesha, Wisconsin. Grinnell-Saunders Diaphragm Valves are used as original equipment on these distillation units because they offer positive, leak-tight closure; flow control in throttling position; corrosion-resistance.

You'll find Grinnell-Saunders valves widely used in other fields, too . . . petroleum, papermaking, chemical, food, compressed air . . . to mention a few.

The operating principle of the Grinnell valve is the feature which makes it so adaptable. The diaphragm lifts high for streamline flow in either direction; seals tight for positive closure against grit, scale, solid matter, pressure or vacuum. Bonnet mechanism is completely isolated at all times from the fluid in the line by the diaphragm, preventing corrosion and contamination. Smooth passage, without pockets, eliminates trapping of solids and reduces frictional resistance. And you can get body, lining and diaphragm materials to meet your particular service conditions. Grinnell Company of Canada, Ltd., Edmonton, Montreal, Toronto, Vancouver, Winnipeg.

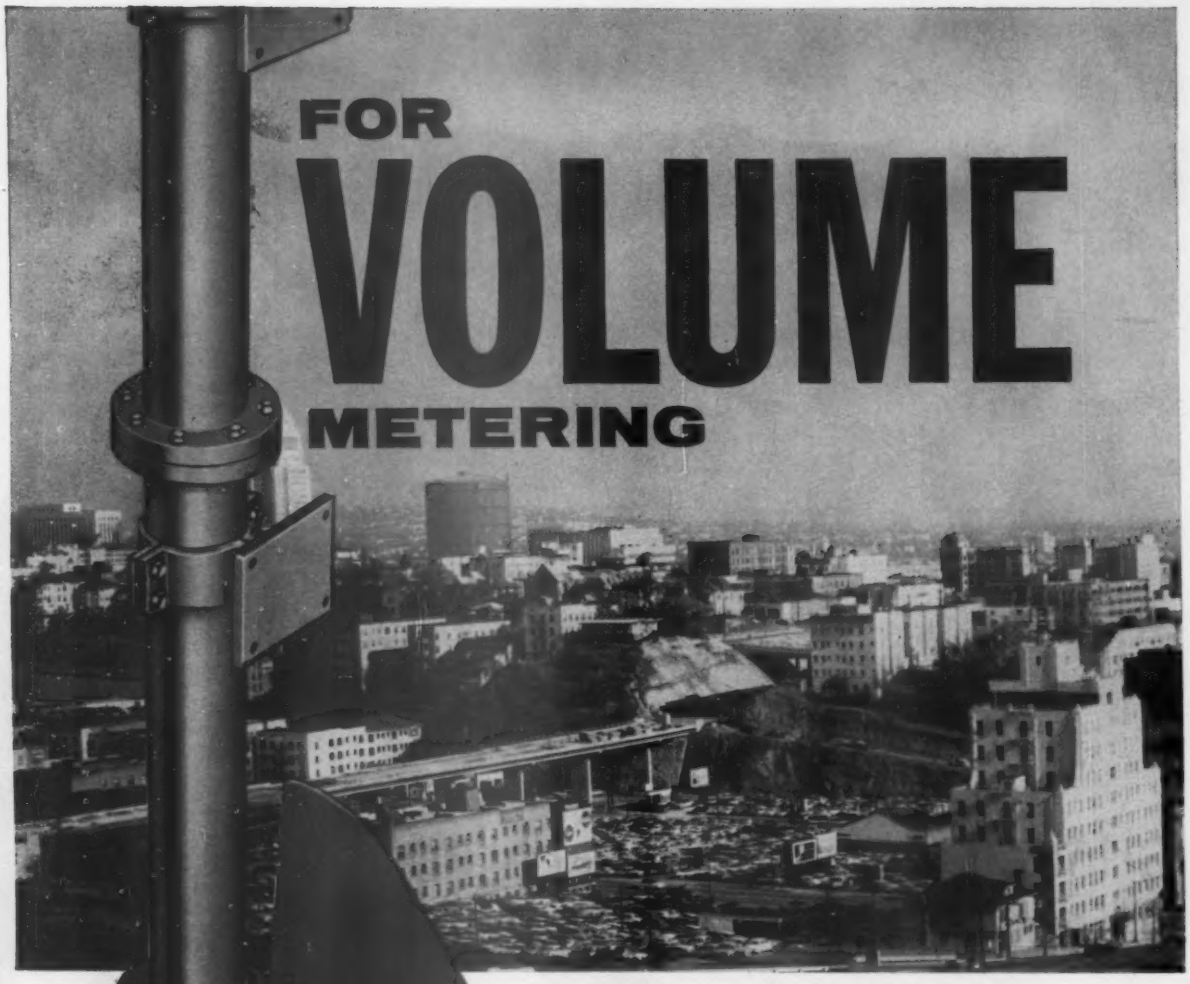


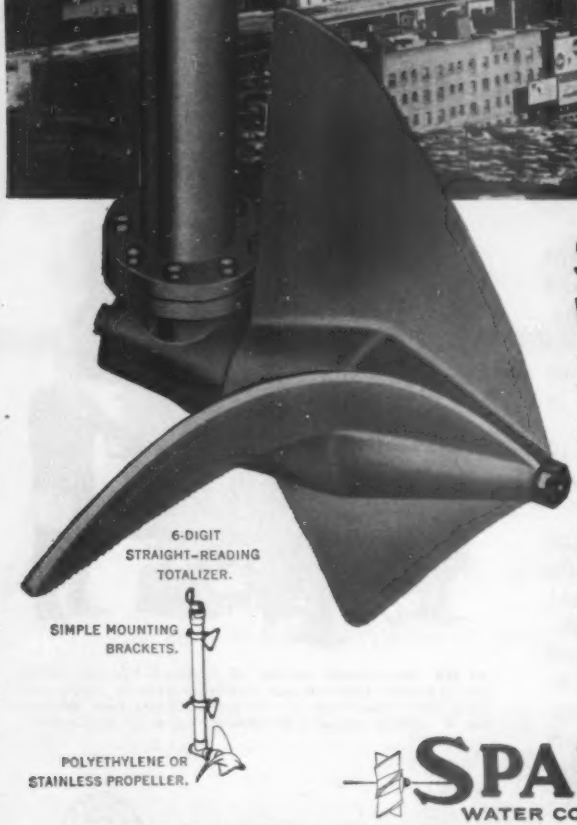


AT SEA The nuclear powered NS Savannah has two 16,000 gallons-per-day Cleaver-Brooks distillation units to supply the entire water requirements of crew and machinery. Each unit has two 4" Grinnell-Saunders Straightway Valves of ductile iron.

GRINNELL

Pipe, Fittings, Valves, Hangers, Heating and Piping Supplies
Branch Warehouses and Distributors From Coast To Coast





SPARLING
WATERWORKS INTAKE METER

Wherever there are large volumes of water to be measured, this versatile meter provides greater control, increased efficiency and the opportunity for more exacting chemical feed. It accurately totalizes flows through closed conduits, inverted syphons, into reservoirs, and at many otherwise unmeasurable points. Negligible head loss makes it ideal for gravity flow systems. Installation is simple. Most perpendicular headwalls or similar structures are suitable, and the meter may be installed, removed, or inspected without interrupting service. Currently used in lines as large as 19' in diameter and can be utilized for even larger sizes.

Call your Sparling representative for complete details, or write for bulletin CF-239-1

SPARLING
WATER CONTROL EQUIPMENT

Hersey-Sparling *Meter Company 225 N. Temple City Blvd., El Monte, California*

East Coast Manufacturing Facilities, Dedham, Mass.

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"from Chicago" An available① means for increasing digester performance

by insuring Homogeneous Sludge through

CONTINUOUS MIXING

Accelerated

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Sludge Digestion System

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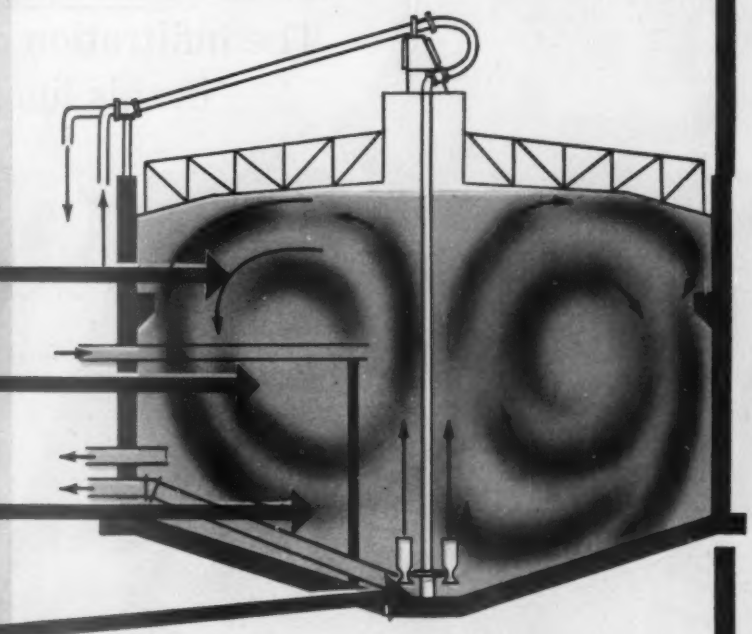

Scum free due to outward radial flow at surface

Greatest loading capacity for accelerated digestion

Continuous Tank Homogeneity and thorough mixing

Highest mixing capacity . . . bottom diffusion with clog-proof GasFusers③ assures total tank mixing

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55 operating and specified installations of the CRP* System with "Chicago" gas mixing equipment since 1955 prove its unparalleled acceptance…serving cities from 2000 to 250,000 population.

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FOOD MACHINERY AND CHEMICAL CORPORATION
HYDRODYNAMICS DIVISION

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Centralized control transforms 33-year-old Kansas City water plant into a model of efficiency

When Kansas City, Missouri, expanded its water treatment plant capacity from 100 mgd to 210 mgd, process analysis and control of the entire plant were centralized. Now, with modern instrumentation, the plant operates efficiently and economically . . . has become one of the world's most advanced water treatment facilities.

Honeywell-designed and installed instrumentation monitors and controls measured variables in the purification, softening, and stabilization processes from a single location. One operator evaluates flow rates, adjusts chemical feeding rates, and maintains constant surveillance over all treatment steps from this point. Pumping operations are controlled from a separate location.

Honeywell instrumentation and service . . . from blue print stage through installation and start up . . . have assisted Kansas City Water Department personnel in meeting present and future water requirements. This has been done at minimum cost, has resulted in a marked upgrading of plant personnel and the production of better quality water. You can gain the benefits of modern instrumentation applied to your own water treatment project from your nearby Honeywell field engineer. Call him today . . . he's as near as your phone.

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Kansas City, Missouri Water Treatment Plant—Hugh G. Carr, Director; Consulting Engineer: Burns & McDonnell Engineering Co., Kansas City, Mo.; General Contractor: Interstate Construction Co., Kansas City, Mo.; Mechanical Contractor: A. D. Jacobson Plumbing & Heating Co. Inc., Kansas City, Mo.

This combined semi-graphic panel and control console comprise the "nerve center" of the Kansas City Water Treatment Plant. Key recorded and indicated variables include raw water flow, temperature, and turbidity; raw water flow to presedimentation basins; settled water flow turbidity; chemical sludge return to presedimentation basins and total chemical sludge flow.

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Honeywell

First in Control

SINCE 1885

"First we thought we'd have to move
Oncle Bull but Tyton lays so easy
he ain't even stirred."

U.S. cast iron **PIPE** FOR WATER, SEWERAGE AND

no fuss, no muss, no cuss!

Fact! Not a worry in a workload with Tyton Joint® pipe. This easy-going pipe is so easy to assemble . . . lays so fast your ditcher has to step on it to keep ahead.

Tyton® is so simple. Only one accessory needed. No bell holes. No caulking equipment. No nuts or bolts to fasten. Minimizes weather worries too. You can lay Tyton in rain or wet trench. That means more working days, more production, lower installation cost.

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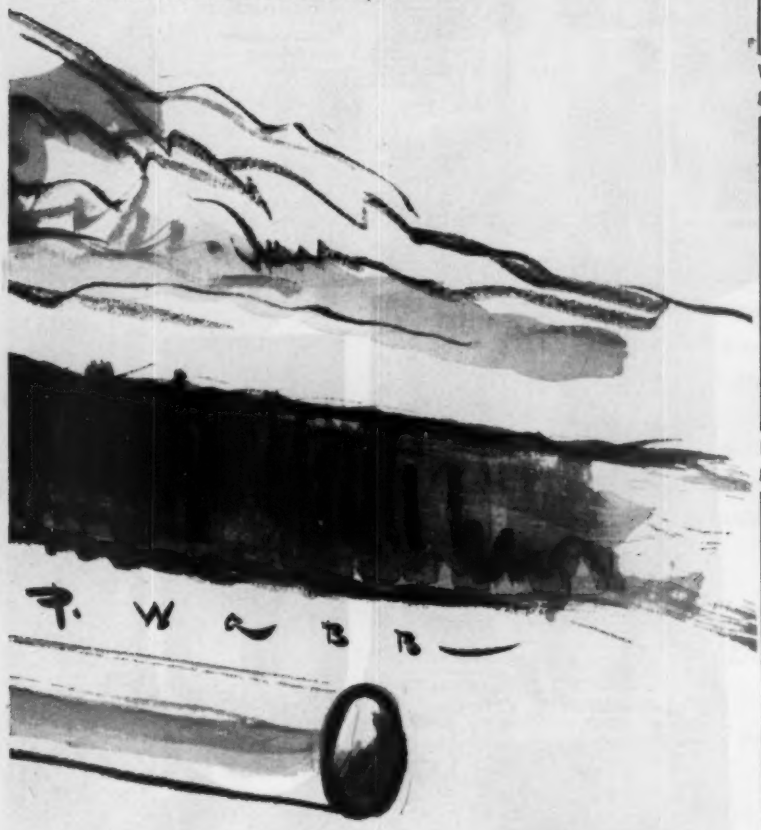
U.S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

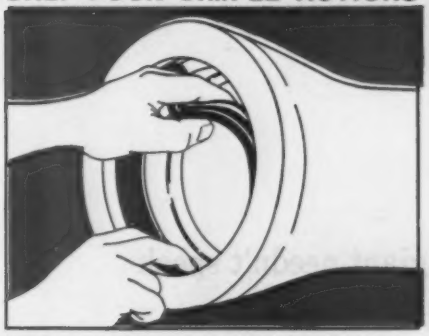
A Wholly Integrated Producer from Mines and Blast Furnaces to Finished Pipe.



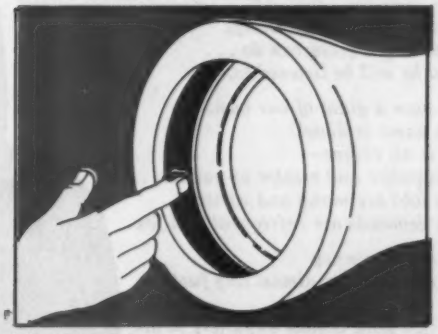
INDUSTRIAL SERVICE CAST IRON

TYTON®

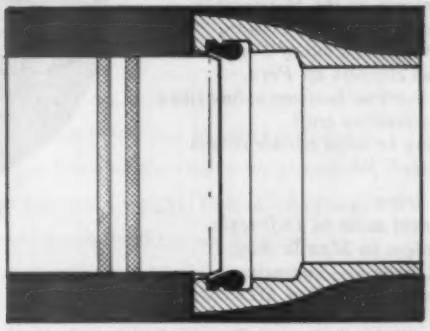
ONLY FOUR SIMPLE ACTIONS



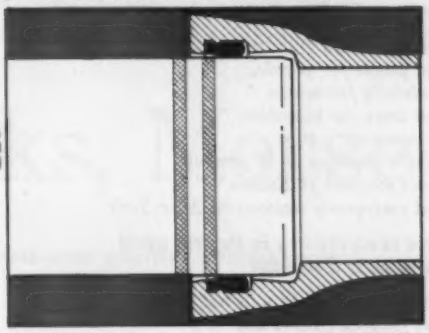
Insert gasket with groove over bead in gasket seat . . . a simple hand operation.



Wipe film of Tyton Joint® lubricant over inside of gasket. Your receiving pipe is ready.



Insert plain end of entering pipe until it touches gasket. Note two painted stripes on end.



Push entering pipe until the first painted stripe disappears and the second stripe is approximately flush with bell face. The joint is sealed . . . bottle-tight, permanently! The job's done . . . . fast, efficiently, economically. Could anything be simpler?

a giant needn't speak to be heard...

. . . he need only be a giant.

he need only do the things
that only a giant can do . . .
and he will be listened to.

we have a giant of our own.
his name is diesel.
he is an engine—
a supplier and creator of power.
his jobs are many and varied,
his demands are infrequent and few.

in an emergency
he can work on almost any fuel.
on assignment
he can work almost anywhere at all.

he makes the boats go . . .
towboats on the Mississippi,
harbor boats in Pakistan,
fishing fleets out of Portugal,
tuna clippers off Peru.
in wartime he drove submarines
and landing craft.
today he helps atomic vessels
do their job.

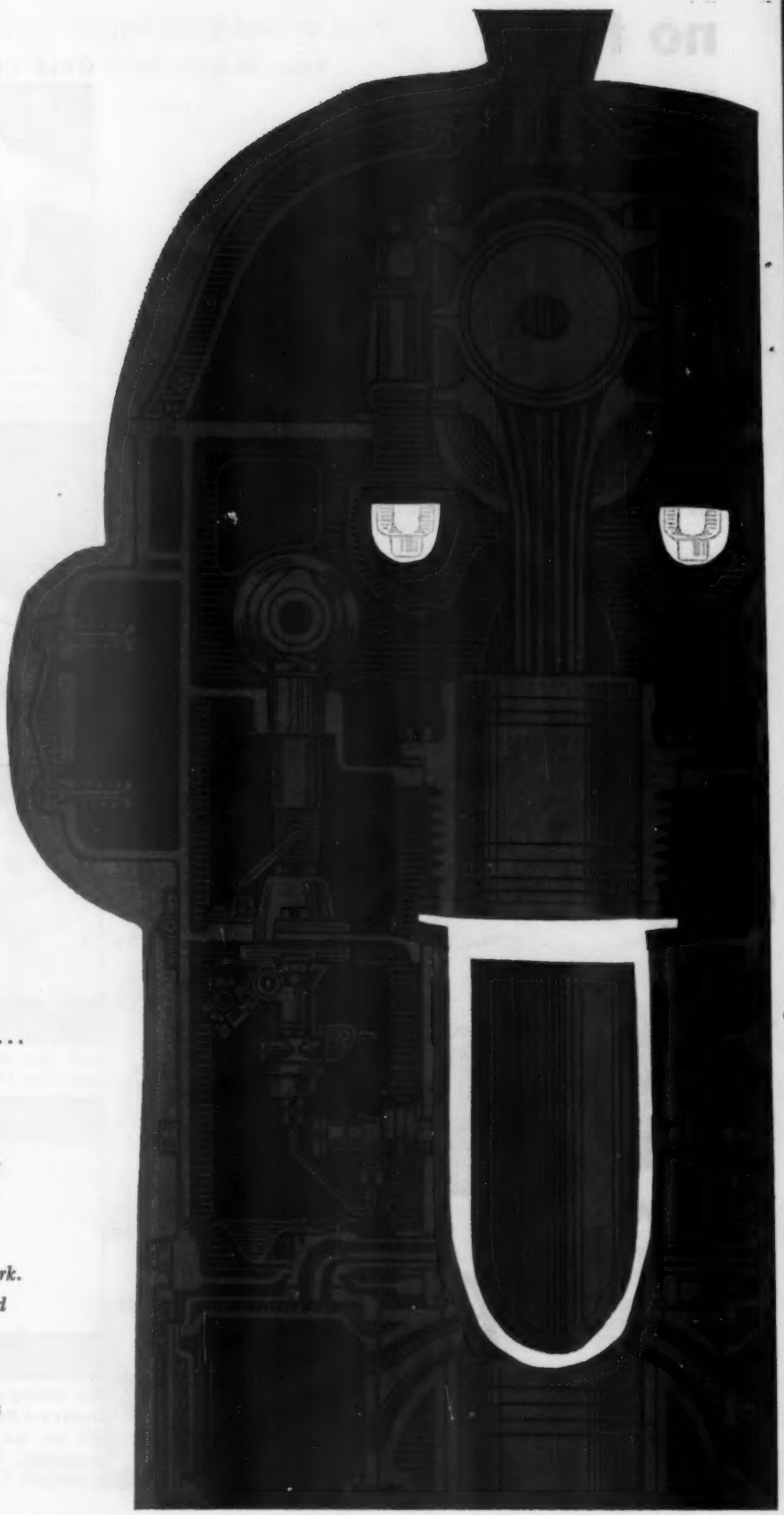
he drives . . .
cement mills in Indonesia,
dredges in Manila Bay,
oil drills in Venezuela,
rigs in the Gulf of Mexico.
he pulls buses, trucks and tractors . . .
locomotives, rock-crushers
and bulldozers.

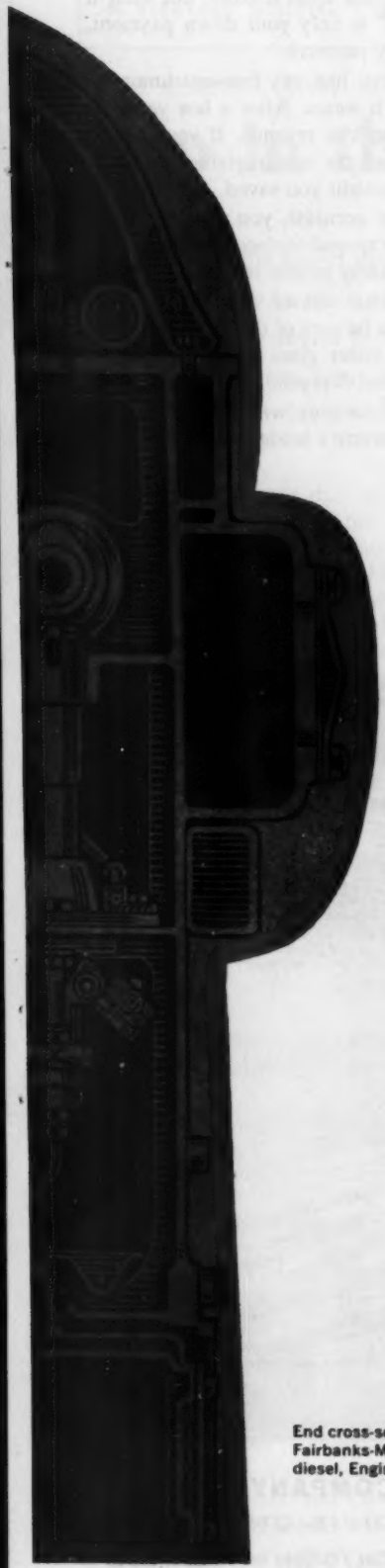
he generates . . .
light for cities
and power for plants,
electricity for homes
and more for hospitals.
he powers
missile stations in Wyoming,
radio stations in Sudan
and emergency stations in New York.

there is no country in the free world
where he is a stranger.

there is nothing he will not tackle
and little he cannot do.

his voice is in his accomplishments
and you hear it every day.





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If your business demands effective, dependable and economical power—you will be interested in learning more about our complete line of diesel engines.

Write to: Diesel Division, Fairbanks, Morse & Co., Beloit, Wisconsin.

Fairbanks, Morse

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ARE YOU GIVING AWAY TONS OF WATER

...just to save a few cents?

The value of a water meter is not what it costs, but what it *earns*. Actually, its "bid price" is only your down payment, and could well be the only *easy* payment.

There are two reasons. First, like any fine instrument, a water meter loses accuracy as it wears. After a few years... or a few months... it begins to lose revenue. If you buy on price alone, you may soon find the meter giving away far more than the few cents you thought you saved.

Secondly, to keep the meter accurate, you may have high repair costs... or premature scrap-and-replace programs. Different makes of meters vary widely in this respect.

Water is your city's most vital service. You entrust it to the accuracy of your meters. To be sure of this accuracy, visit your meter shop. Ask which meter gives highest sustained revenue... with lowest repair and depreciation costs.

We sincerely believe the answer will be "**Trident.**" 15,000,000 since 1898... the world's leader.

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Vol. 107, No. 8 • August, 1960

A Scranton Gillette Publication

WATER & SEWAGE WORKS

Israel diverts a river to provide a . . .

Tap in the Desert

By PHILIP GILLON

ED. NOTE: This report describes the physical and political difficulties faced by Israel in securing water for irrigating the Negev. Although much remains to be done before her neighbors can report similar success, many previously desert acres are now being cultivated in accordance with Israel's master plan.

■ THE BIBLE records that when the children of Israel were in the wilderness of Zin they had no water until Moses struck the rock at Meribah, and "the water came out abundantly".

More than three millenia later, a miracle of modern science enables the Bedouin of Israel to water their camels by turning a tap in the desert. For centuries they have scratched the sandy bottoms of the ravines for hidden but brackish water. Now the tap they turn releases clear river water from a stream which most of them have never seen, and which up until now flowed unchecked to the Mediterranean, a hundred miles to the North. The Yarkon river has been turned into Israel's Negev, the southern rolling area opposite the Sinai desert.

Irrigation means an advance for civilization in countries like Israel where rainfall is uncertain and concentrated in short seasons. Even before the State of Israel existed, it was realized that all the pioneering spirit, dedication and courage in the world would not enable the Jews to absorb hundreds of thousands of immigrants if they could not marshall millions of additional cubic feet of water. Dr. Walter Clay Lowdermilk, the Assistant Chief of the Soil Conservation Service of the United States, was enlisted as adviser.

Dr. Lowdermilk proposed the creation of a Jordan Valley Authority to provide both water and power. He contemplated a national water plan for Palestine in which the waters of the Jordan pouring unused into the Dead Sea would be harnessed, and those of the Yarkon diverted from the Mediterranean. He was convinced that with such a master plan both the Jordan Valley and the Negev could be brought to sufficient fertility to support an additional population of millions. Soil samples indicated that the superficially unattractive, loess soils of the Negev could yield abundant harvests of all kinds of crops —if irrigated.

Dr. Lowdermilk also proposed the adoption of a regional approach to

LAYING YARKON-NEGEV Pipeline. Line runs about 66 miles from Tel Aviv to Mintahim.

QULA RESERVOIR showing grass impurities trap covering floodgate.

the irrigation problems of the entire Near East.

Detailed engineering studies of the Jordan River plan were published in 1948 by two eminent Americans: the late James B. Hays and J. L. Savage. It is perhaps significant that the water plan and the State of Israel emerged during the same year.

After the War of Independence in Israel, as the present frontiers of Israel were demarcated, Lowdermilk's scheme had to be modified. Israel engineers and American advisors prepared a new master plan to ensure the maximum use of all water resources in the country. Not only was all river water to be used through deviations, but underground and surface waters of other kinds were to be tapped and dammed. Waste was to be eliminated by law. Radical changes were necessary: there was an annual surplus in the North of 4000 million cubic feet, a shortage in the South of 2250 million cubic feet. It was calculated that the country's resources could be increased to 18,000 million cubic feet a year, sufficient to irrigate almost three-quarters of a million acres of land, as compared to 75,000 acres in 1948.

The master plan provided in detail for the damming-up of winter floodwater; the use of artesian wells, and the recharging of wells by dams; the reclamation of the Huleh swamps and the development of the Kishon stream in the North into a major irrigation project; the redemption, for agriculture, of water from the sewage of the great cities; and the utilization of the waters of the Yarkon and part of the Jordan River. The capital sums involved were estimated to come to some $400,000,000.

In Jordan, the Government engaged a British firm, Murdoch Macdonald and Partners, to prepare a plan for the exploitation of the Yarmuk and Jordan Rivers in Jordanian territory. (The Yarmuk is the Jordan river's main tributary). A further scheme suggested by Mills E. Bunger of the American Technical Cooperation Agency contemplated the building of a great dam on the Yarmuk, thus cutting off a major part of the supply to the Jordan river. It was apparent that this unilateral use of the Yarmuk would radically affect Israel. Traditionally, international law has protected riparian owners, and Israel objected vigorously to the proposed deprivation.

The United Nations in 1953 suggested the creation of an international water authority to control the exploitation of the Yarmuk and Jordan Rivers. The Boston firm of Charles T. Main, Inc., drew up a plan for "The Unified Development of the Water Resources of the Jordan Valley Region" which was submitted as a compromise to Israel and the Arab States. The President of the United States sent Mr. Eric Johnston to the Middle East to negotiate an agreement on the basis of the Main plan.

Under this plan, Israel was to receive only 33% of the Jordan river's water instead of 50% as proposed by Savaga and Hays. The diversion to the Negev would be impossible, an insuperable obstacle for Israel. Nevertheless, she agreed to negotiate; so did the Arabs after they had first refused.

Plans and counter-plans were produced by both sides throughout the next two years, Mr. Johnston, as intermediary, making several further trips. Each time he grew more hopeful of securing an agreement. In February, 1955, he felt that he had reached "the ten yard line". By August, 1955, he produced a new compromise plan whereunder Israel was to receive 40% of the Jordan instead of 50%—in actual measurements, 3600 cubic million feet a year, instead of 5000 million. This demanded a major concession. Jordan was to get her dam on the Yarmuk.

The Arab States formed a Technical Committee which approved the new Johnston plan. Israel agreed reluctantly to the sacrifice. Mr. Johnston claimed exultantly that they had reached the "one inch line". All the countries concerned had approved the plan, save for "minor differences which could readily be reconciled".

At the fifty-ninth minute of the

eleventh hour, the Arab politicians calmly killed the project which their Technical Committee had approved. Mr. Eric Johnston describes himself what had happened in "The New York Times Magazine", of October 19, 1958:

". . . . . After two years of discussion, technical experts of Israel, Jordan, Lebanon and Syria agreed upon every important detail of a unified Jordan plan. . .

"But in October 1955, it was rejected for political reasons at a meeting of the Arab League. Syria objected to the project because it would benefit Israel, as well as the Arab countries. Three years have passed and no agreement has yet been reached on developing the Jordan river. Every year billions of cubic feet of precious water still roll down the ancient stream, wasted, to the Dead Sea."

The Johnston Plan has been shelved indefinitely. By 1959, Israel had completed aspects of her own master plan, including the first Yarkon deviation, bringing water to the south, the reclamation of the Huleh, and the development of the Kishon basin. Giant 108-inch pre-stressed concrete pipes are being laid into position for the Jordan river deviation; the Israel plan can still be adapted to the Johnston formula. Jordan is working on a plan of its own to exploit the Yermuk which may endanger Israel's interests.

Despite all the difficulties, Israel has succeeded in increasing the amount of irrigated land fourfold in the last decade. Two hundred thousand refugees from persecution have re-established their lives in the South, in badlands once condemned as incapable of supporting human life. For the first time in thirteen hundred centuries, civilization in the Near East is on the march against the desert.

Conversion of U.S. and British Units to Metric Equivalents

For engineers, technicians and executives concerned with the expanding volume of trade and interchange of technical information between the U.S. and Europe, a 40-page handbook of reference tables for converting U.S. and British units into metric units (and vice versa) has been published by European Technical Coverage of Chicago.

The pocket size reference has conversion tables in the nine areas of temperature, volume, weight, liquid volume, pressure, heat units, units of length and surface and production. For rapid conversions, the tables have stepped-down thumb indexes and the user can quickly locate a known value in any particular table and on the same horizontal line find the equivalent values in the other systems.

In addition to the tables, five pages of the spiral bound book are devoted to conversion factors for length, area, volume, dry volume, liquid volume, specific weights, pressures and quantities. The book is available from European Technical Coverage, Inc., 75 East Wacker Drive, Chicago 1, Ill.; the price is $2.56 a copy, postpaid.

Hanford's reactors use some Columbia River water for cooling purposes. Effluent from the reactors when discharged into the river contains several radioisotopes generated during its quick pass through the reactors. Columbia River water at Pasco contains about 15 per cent of the maximum concentration of radioisotopes permitted by the national radiation health authorities. After treatment in the Pasco filter plant, the 15 per cent of the permissible concentration is reduced to about five, even though this plant is not designed and is not operated for this purpose.

Mr. Junkins further explained that the plant's efficiency in removal of radioisotopes varies with the seasonal demand for water. It is least efficient during summer months when the water plant is operating near capacity and there is less time for radioactive decay as the water passes through the treatment plant. However, this corresponds with the highest rate of flow of the Columbia river when the effluent from the reactors is diluted most by increased water from the mountain snow melt.

Some of the radioisotopes are removed by sedimentation and filtration. The solid wastes from these sources are periodically removed by flushing. Because of radioactive decay, there is little accumulation of radioisotopes in these solids.

Omaha Votes For More Sewers

Omaha, Neb., voters recently approved by a 3-to-2 margin the issuance of $3,000,000 worth of sewer bonds. The vote will give city officials the power to satisfy the most urgent sewer requirements without having to raise the property tax levy.

Of the money raised by the bonds, $1,500,000 is scheduled for the completion of financing of the Saddle Creek sewer. One-fourth of the funds, $750,000 will be spent at the rate of $250,000 a year, starting in 1961, to continue a sewer building program started ten years ago.

The remaining $750,000 will be used to pay temporary notes that were issued to finance emergency storm sewers built after the 1959 floods.

R. S. Rankin Dies

The death of Renville Stevens Rankin on June 6, at Stamford, Conn., following a brief illness, ended a career of forty-seven years devoted to the advancement of sanitary engineering practices in the United States and abroad. Mr. Rankin was 68.

His earliest association with the sanitary engineering profession came during and directly following his student years, at the water filtration plant of the city of Minneapolis. He joined the New York consulting engineering firm of Greeley and Hansen in 1917, remaining with them for ten years.

Later, he was an active member of Dorr-Oliver, Inc., sanitary engineering staff from 1927 until he retired in 1956. Subsequently, he continued as a consultant to the company and its subsidiaries abroad.

In 1948, Mr. Rankin won the Kenneth Allen Memorial Award, presented by the New York Sewage Works Association for his writings on "Digester Capacity Requirements."

He was a member of the ASCE, American Academy of Sanitary Engineers, New England Sewage and Industrial Waste Assoc., a former director of the A.W.W.A., a trustee of the American Sanitary Engineering Intersociety Board, president of the Water Pollution and Control Federation, and the Water and Sewage Works Manufacturers Association.

Abstracts of papers presented at the . . .

Second Sanitary Engineering Conference—*Part II*

EDITOR'S NOTE: Last month, the papers resuméd considered radiation and its effects on man and his environment. This month, in Part II, the papers treat the problems of radioactivity in public water supplies, the problems of its removal, and the problems involved in monitoring.

Water Supply Implications And Methods of Removal, Conrad P. Straub, Chief, Radiological Health Research Activities, U. S. Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Radioactive materials found in surface waters generally arise from fallout, naturally occurring radionuclides, manmade radionuclides released during operations of nuclear energy facilities, and the spent residues from use of specific radionuclides for beneficial purposes. At the present time, the bulk of radioactivity in surface waters has its origin in fallout and natural radioactive materials.

Generally speaking, activity levels should be somewhat lower in streams than in reservoirs, lakes, or impoundments. Cisterns constitute another source of water supply which contain radioactivity from fallout.

The makeup of the activity must be known before the significance of any given level can be determined, particularly since there seems to be no direct ratio between the gross beta activity and strontium-90 levels. The most hazardous man-made radionuclide is strontium-90. Radium is the most hazardous of the naturally occurring radionuclides, and is encountered in some ground water supplies in significant levels. There is an appreciable removal of gross strontium-90 between its arrival on earth as fallout and its presence in the stream as runoff.

Removal of radioactive materials by water treatment processes must be considered in terms of several facts. The treatment process transfers the radioactive material from one phase to another (liquid to solid), but does not reduce the total radioactivity, except by decay. The quantities of material involved are extremely small. The degree of treatment to be provided must be geared to the maximum permissible concentration.

Coagulation with settling has not been particularly effective for removal of radionuclides except for most cations of valence 3, 4, or 5, including the rare earths. Coagulation will be helpful in the removal of radioactive material associated with suspended matter in water.

Sand filters are not effective in removal of radioactive materials except for removal of particulate matter and whatever radioactive materials is associated with it.

Lime-soda ash softening, especially with excesses of both chemicals, is effective in removal of strontium, barium, etc. Ion exchange is quite effective in removal of radioactive materials in solution. Mixed bed or cation and anion beds in series are recommended.

Phosphate coagulation and electrolytic cells with permselective membranes are promising among non-conventional water treatment processes for removal of radioactive materials. Metal powder or clay materials can be added to adsorb soluble radioactive constituents. The clays are then removed by coagulation and settling.

Generally speaking, water treatment processes will be ineffective for reducing the activity in water to acceptable safe limits, unless the activity levels are very low.

Radioactivity In Texas Streams, W. R. Drynan, E. F. Gloyna, and D. F. Smallhorst, Research Engineer, University of Texas; Professor of Sanitary Engineering, University of Texas; and Director, Water Pollution Control Division Texas State Department of Health, respectively. Surface waters may contain varying amounts of radioactivity, originating from natural radioactive deposits, nuclear weapons tests, industries, hospitals, and research institutions. Because the manmade radioactive fractions are becoming more prevalent, progressive water pollution control agencies are seeking basic data regarding radioactivity.

Realizing the need for this data, the Texas State Department of Health initiated a three year program with the University of Texas to collect base line data on the radioactivity in Texas' waters. This program consists of collecting and analyzing samples from about 120 sampling points which are located near gaging stations maintained by the U. S. Gelogical Survey. Monthly samples are collected, in most cases, by Game Wardens of the Texas Game and Fish Commission.

All samples are screened for gross alpha and beta activity associated with the suspended and

dissolved fraction of the water. If these preliminary tests indicate significant quantities of either beta or alpha emitters, a gamma spectrum and a radiochemical separation of strontium and radium may be made.

An automatic proportional counter is useful for beta counting, but alpha activity is counted on a manually operated internal proportional counter. An electrometer utilizing a 4-inch diameter planchet records individual alpha pluses. The gamma spectrum is obtained from a 256-channel pulse-height analyzer operated in conjunction with a three by three inch scintillation crystal.

Although the results vary a great deal with respect to location and time, most of the samples collected throughout the entire state of Texas had less than 50 micromicroocuries per liter of beta activity and 10 micromicrocuries per liter of alpha activity. When the beta activity is low, most of it is in the suspended fraction. However, as the beta activity increases, the filterable liquids contain as much activity as that collected on the membrane filters.

A more detailed study of the relationships between stream flow, solids content and radioactivity levels is being made with data from the Trinity River. Daily samples have been collected for a year from the West Fork of the Trinity River in Dallas. The suspended solids content of the stream is directly proportional to the stream flow. Up to about 1000 cfs the beta activity associated with the suspended solids increases with stream flow. With flow about 1000 cfs the radioactivity remains almost constant or decreases slightly although the solids content increases. The effect of increased stream flow is to reduce dissolved solids by dilution. Up to about 500 cfs, the radioactivity may increase because the rainfall which produces the increased stream flow contains radioactivity from weapons testing. Above 500 cfs, the radioactivity decreases at about the same rate as the dissolved solids.

Approximately 2,500 samples of Texas' waters have been assayed for gross radioactivity.

Natural Radioactivity In Illinois Water Resources, T. E. Larson and R. L. Weatherford, Head of Chemistry Section and Assistant Chemist, respectively Illinois State Water Survey Division, Urbana, Illinois. Since May, 1957, the Illinois State Water Survey has been measuring the gross alpha and beta activity on samples of well water and streams and rivers. The counting is being made on proportional counters using nonvolatile residue remaining after evaproation of the water carrier. The levels of "natural" activity were determined to be extremely low so that little confidence can be vested in the numerical magnitude of the "natural" activity.

About 300 well water samples have been examined. At least 90 per cent of the samples showed a beta activity in the range of 10 to 90 $\mu\mu$c/1. Generally, the gross activity found in St. Peter and Galesville sandstones is higher than that in waters from limestone and dolomite, and both are higher in activity than water from unconsolidated formations. Alpha activity in waters from these formations decreased in the same order. In general, then, both the alpha and beta activity increased with age of formation. Likewise radium—226 concentrations have been found by Argonne National Laboratory to be higher in the sandstones than in the limestone or unconsolidated formations of more recent origin. The gross beta activity eceeded 100 $\mu\mu$c/1 in only one sample of 126 samples from the sandstones and none of the samples from the limestone or unconsolidated formations. At least 90 per cent of the samples showed beta activity in the range of 10 to 90 $\mu\mu$c/1.

Water from the Illinois River at Peoria has been sampled bi-weekly since February, 1958 and assayed separately for gross beta activity in the dissolved and suspended solids. The median total beta activity was 40 $\mu\mu$c/1 and exceeded 100 $\mu\mu$c/1 in 20 per cent of the samples. The total activity is not related to turbidity. High total activity is associated with high rainfall and stream flow. The average daily dissolved activity passing the sampling point at the time of collection is lowest at periods of low flow.

The minimum recorded dissolved beta activity in the Illinois River at Peoria has been computed in microcuries per day per square mile. These values have then been compared with similar data from other Illinois streams. In general, the minimum recorded load increases with increasing watershed area due to sustained flow contributed by runoff. The minimum load is less than 10μc per day per square mile and in sixteen of nineteen streams other that the Illinois River, it is less than 1.0 μc per day per square mile.

Aquatic and Biological Factors In Natural Waters, Louis A. Krumholz, Associate Professor, Department of Biology, University of Louisville. Radioactive materials being introduced into natural waters originate from three general sources: (1) natural radioactive materials, (2) fallout from weapons tests, and (3) radioactive wastes from hospitals, laboatories, and atomic energy installations. The first of these is constant, the second is variable, but the third is increasing.

Living oganisms are not capable of distinguishing between radioactive and stable isotopes of the same chemical element. Organisms select certain elements for their metabolism and concentrate them. Radioactive isotopes of these elements are concentrated within the organism.

Just as each radionuclide has a characteristic physical half-life which describes the rate of decay of the unstable nuclei, each organism has a characteristic biological half-life which describes the average residence time of atoms of a particular element within the tissue of the organism. The biological hazard of a radionuclide must be determined on the basis of its requirements by the organism and the length of time it remains in the tissues.

The amount of a radionuclide taken up is proportional to the concentration of that element in the environment. It may also be altered by the relative abundance of another element in the environment. Each organism has its own particular environment within a

natural stream system and the demands of these organisms on their environment are as varied as the organisms themselves.

Radionuclides accumulated by aquatic organisms are not removed from the environment, but are merely transferred from the liquid to a solid phase. When the organism dies or is consumed by another organism, the radionuclide is returned to the environment. The complexity of the problems that will arise concurrent with long-term disposal of radioactive wastes into any aquatic environment has been emphasized by many investigators.

Radioactive materials may be accumulated by aquatic organisms by ingestion by absorption through the body surfaces, or by adsorption on body surfaces. Concentration of radionuclides by organisms by the first two of these methods can be considered better if the organisms are arranged as they fit into the trophic levels of the ecological system. The three principal categories are the primary producers, or photosynthetic plants, the primary consumers, or herbivores, and the secondary consumers, or carnivores. Radioactive materials are transferred through the food web from one tropic level to another.

It is apparent that any concentration of radionuclides by aquatic organisms will be governed by many factors operating in the environment: 1) elemental composition of organism and its requirements, 2) availability of materials as determined by their physical or chemical state, 3) relative abundance of radionuclides in relation to stable counterparts; 4) physical half-life, 5) biological half-life, 6) presence of other elements, 7) type of environment, 8) season of the year, and 9) species composition of the biota. With such a complex array of factors, it is readily apparent that the problem is not a simple one with a simple solution. In fact, the problem is so diverse that it will require the close cooperation of qualified research personnel in several disciplines.

The Problems of Monitoring, G. Hoyt Whipple, School of Public Health, University of Michigan. Surveys of environmental radioactivity may be carried out to determine whether levels dangerous to human health, economically important biological species, or certain manufactured products are being approached, whether the operator of a nuclear facilty is conforming to legal limitations on release of radioactivity established by regulatory agencies, or to gather legal evidence for adjudication of claims of injury.

Among those who might have some interest and responsibility for monitoring the levels of radioactivity in the environment would be all agencies concerned with public health at federal, state and local level, agencies responsible for promoting licensing and regulating atomic energy activities, the operator of a nuclear facility, and an independent "third party". Pre-operational or background surveys before a nuclear plant goes into operation are important in providing a basis for evaluation of later data.

Environmental media of primary importance because they are consumed by humans include air, water and food materials. Of secondary importance are soil and sediment and biological organisms not used for human food. All of these are often monitored, but legal limits for maximum permissible concentrations have been formulated only for air and water. Common sense and good judgment should be exercised in selecting samples from these media for analysis and in interpreting the results. Sampling frequency will depend upon the characteristic variation in radioactivity for each environmental media.

Problems are encountered in obtaining samples which are representative of the environment. Large volumes of sample must be obtained because of the very low concentrations of radioactive material in the environment. Equipment used for analysis of samples is rather expensive, and the standards used for calibration of these instruments must be carefully chosen.

An example of a survey is the one being carried out for the operator of a nuclear plant for the past two years. Samples were collected at an average rate of one hundred per month. The sample media include airborne dust, rain, surface water, underground water, food materials and biological materials. All samples were analyzed for gross beta activity. In addition, about 10 per cent of the samples were analyzed for one or more radioelements.

Monitoring the Radioactivity In Chicago Water Supply, James C. Vaughn, Filtration Engineer, South District Filtration Plant, Water Purification Division, Department of Water and Sewers, City of Chicago. The management of the Chicago water works system recognized at an early date after World War II that harmful radioactive contamination of its Lake Michigan water supply might occur in the future. Studies were started in 1949 to develop basic data on the natural background levels of radioactivity in uncontaminated Lake Michigan water. Tests were also started to determine what decontamination efficiency could be expected from the conventional filtration process.

The monitoring program in Chicago is divided into three phases: continuous monitoring, regular sampling and counting of raw and treated water, and sampling and counting of precipitation.

The continuous monitors consist of Geiger tubes with flowing wells, count rate meters and continuous recorders. One tube monitors raw water and the other monitors treated water. Gamma rays and some beta particles are detected with the thin end-window tubes. Sensitivity of the monitor enables detection of radioactivity levels around 1/100 of emergency tolerance levels.

A proportional counter is used to measure radioactivity concentration in the range of levels normally encountered in surface supplies. Samples of both raw and treated water, after proper preparation, are assayed daily in the proportional counter. Preparation of samples involves evaporation of a large volume, concentration of the activity on a small area, and drying thoroughly. One liter samples are evaporated to 20 ml and then transferred to a 2¼ inch planchet and dried. This procedure takes about a day.

Improved wastewater treatment is possible, as well as the . . .

Syndet Removal from Drinking Water *using Activated Carbon*

by MAXIM LIEBER, Prin. Sanitary Chem.
Nassau County Dept. of Health
Div. of Laboratories and Research

RESUME: Mounting use of syndets and their increasing prevalence in both ground and surface waters dictate action to combat resulting water quality deterioration. This work with activated carbon describes reduction in syndet content of a ground water supply and suggests its use at wastewater treatment plants.

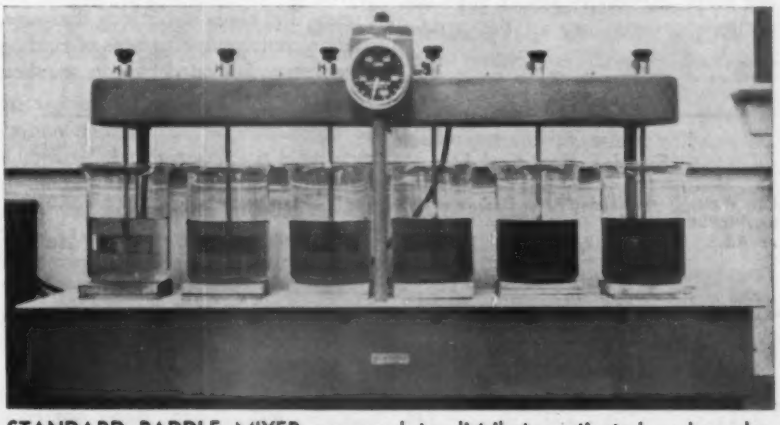
■ SURFACE-ACTIVE AGENTS, exhibiting detergent properties, are now in common use by industry and in the home. As a result, the presence of synthetic detergents has become more apparent in our waterways and streams throughout the country. Also, in areas such as Nassau and Suffolk counties in New York, the ground waters have been found to contain varying quantities of synthetic detergents. Here, the sand and gravel soil serves as a good source of water supply and an ideal medium for the disposal of sanitary and industrial wastes.

The detection of industrial waste contaminants has become more prevalent in ground water aquifers,[1,2] but many of these can be removed by adequate industrial waste treatment before discharge to the ground. However, the common use of syndets in home and industry, with its ultimate disposal to cesspools along with sanitary and industrial wastes, presents a far more complex situation. The literature is extensive on the existing difficulty in removing syndets by conventional sewage treatment methods. The normal biological degradation of organic wastes in cesspools is also ineffective in the decomposition of synthetic detergents. This has been confirmed by observations made in a study completed in Suffolk County.[3]

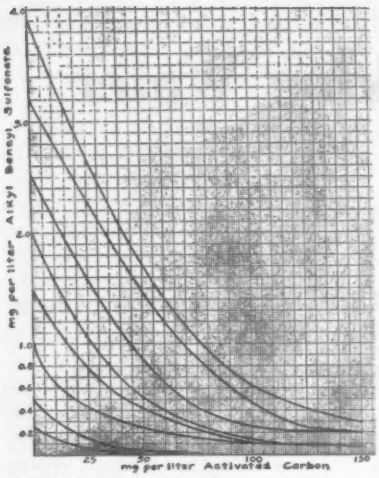
In the Long Island area there has been a rapid rise in the population densities. This has been accompanied by increased construction of residential homes, many of which have their individual cesspool or septic tank. Some of these homes also have their own private shallow wells as a source of water supply. The detection of the synthetic detergents in the shallow wells discloses what is occurring to the shallow ground water table and what may be anticipated for the future in deeper ground water aquifers. Once these syndets pass unaffected through the cesspools, the possibility of any additional degradation or decomposition taking place is nil. Consideration must therefore be given to the possibility of their removal. A water supply containing 1.0 to 1.5 mg per liter of detergent as Alkyl Benzyl Sulfonate (A.B.S.), possesses taste characteristics detectable by many individuals. That, plus the foaming effect noted on agitation makes such a supply unpalatable.

Activated carbon has been employed for concentrating syndets in the methodology of laboratory analytical procedures. Since this method of concentration and separation of synthetic detergents from water is very effective, an attempt was made to determine the potential of utilizing activated carbon in water supply treatment for syndet removal.

A standard suspension of activated



STANDARD PADDLE MIXER was used to distribute activated carbon dosages in water samples containing syndets.



REMOVAL OF A.B.S. in Jar Tests using Activated Carbon.

carbon was prepared containing 10 grams of Nuchar W* per liter of distilled water. One milliliter of the carbon suspension per liter of water will give a concentration of 10 mg per liter of activated carbon. Jar tests were made on distilled water dilutions of shallow well waters containing synthetic detergents. With each prepared dilution, varying quantities of activated carbon were used. The paddles on the mixing machine were set to rotate at 100 rpm for three minutes and then at 50 rpm for seven additional minutes. The test samples were immediately filtered. The methylene blue extraction procedure[4] was used to determine the syndet values in both the raw and treated waters.

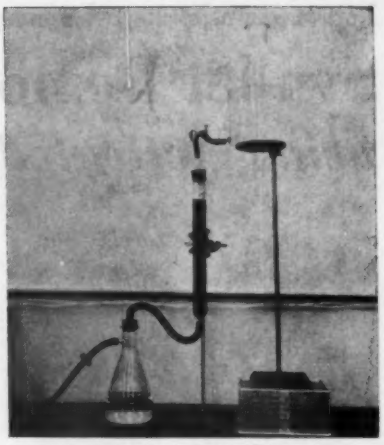
Table 1 contains the observed data. This information was plotted in Figure 1. For all practical purposes, the adsorption of syndets by activated carbon follows the Freundlich Equation. Thus the latter traces of syndet are more difficult to adsorb than the earlier portions, or, as the syndet concentration of a water supply increases, a higher carbon dosage will be necessary to accomplish the desired removal. This increased carbon dosage is not proportional to the increased syndet value of the raw water. It is interesting to note that the plant application of activated carbon for taste and odor control has been shown to be more efficient than that found in laboratory tests. Similar efficiencies may be anticipated for the removal of syndets on a plant scale to the extent of using approximately 25 per cent less activated carbon.

This type of treatment would necessitate a plant employing mixing and settling basins and possibly a filtration unit, but such elaborate treatment procedures are not practical for the Long Island ground waters. The quality of these waters has always been excellent, since the soil is principally sand and gravel. Water obtained from properly placed and constructed wells is generally free of bacterial contamination and in some instances is pumped directly from the well into the distribution system without treatment. In other instances, chlorination is practiced to retain a chlorine residual for protective purposes.

The individual home owner with the private shallow well is the one who is currently experiencing difficulty with syndet contamination. It would be advantageous to find a practical treatment procedure that could be used to remove syndets from these well supplies.

Experimental Apparatus

A laboratory treatment unit was assembled utilizing a column of granular activated carbon, as shown in Figure 2. This is a 1.5 inch diameter column containing 80 grams of Barnebey-Cheney activated carbon number SC5. Experiments were conducted using well waters containing high syndet values such as 2.12 and 6.4 mg per liter as A.B.S. On passage through the carbon column, there was a high percentage of syndet removal producing filtrates of 0.03 to less than 0.02 mg per liter as A.B.S. Passage through the column was accomplished both by gravity flow and suction. In both cases the removal was equally efficient.



LABORATORY APPARATUS showing reservoir and column of granular activated carbon.

An attempt was made to apply this treatment on a practical scale. A small filter bed of granular activated carbon was fabricated as illustrated in Figure 3. This bed was constructed of 2 inch galvanized pipe, filled with 250 grams of Barnebey-Cheney activated carbon number SC5 and accommodated with garden hose hardware on either end. The carbon bed inside this pipe rested on glass wool placed as a strainer at the bottom of the filter. The influent end of the filter had a valve used to regulate the flow of water into the column. A pressure gauge was tapped to the bottom of the filter to measure the effluent pressure from the carbon bed. The depth of the carbon bed was approximately 10 inches.

A private well supply was chosen which contained a syndet contaminant. This well was 30 feet deep and located approximately 30 feet south of a cesspool. There were no other cesspools within 125 feet of the well. Past ground water studies established the ground water flow in the area to be in a southeasterly direction. The well was driven 18 months prior to the study, but six months after

*Product of the Barnebey-Cheney Co.

Table I
Syndet Residual by Jar Test, mg/Las A.B.S.

Raw Water mg/liter as A.B.S.	Remaining After Dosage of — mg per liter Activated Carbon									
	5.0	12.5	25.0	37.5	50.0	75.0	100.0	150.0	200.0	250.0
0.25	0.19	0.13	0.06	0.05	<0.02	<0.02				
0.48		0.30	0.15		0.04	<0.02	<0.02	<0.02		
1.02			0.40		0.24		0.10	0.08	0.03	0.03
1.48			0.76		0.45		0.10	0.06	0.04	0.02
2.00			1.03		0.52		0.14	0.07	0.04	0.02
2.52			1.56		0.85		0.24	0.19	0.03	0.03
3.18			2.28		1.48		0.45	0.20	0.10	0.08
3.90			2.60		1.80		0.62	0.29	0.20	0.09

installation, the owners detected a taste and odor in their water supply.

Bacteriological water samples collected from both the kitchen and bathroom water taps indicated the water to be free of Coliform contamination. These results were consistent with those noted in other private shallow wells that are contaminated with syndets. The water from the test well was passed through the carbon filter bed with an effluent pressure of 5 to 8 psi and samples were collected for syndet analysis at intervals of 5 gallon treatment periods. Table 2 is a tabulation of the samples and syndet values obtained on analysis. It is interesting to note that the syndet content of the raw water increased slightly with pumping. Since the origin of the contaminant is from the adjacent cesspool, this slight increase on continuous pumping is conceivable. The ability of activated carbon to remove syndets is evident. In fact, its effectiveness is more apparent when it is realized that the raw water was passed under pressure through a short column of activated carbon.

Two-Stage Treatment

An examination of the data in Figure 1 would indicate an increased efficiency for syndet removal by use of a double stage treatment process. To verify this, a water containing 1.89 mg per liter as A.B.S. was treated with graduating quantities of activated carbon to give a satisfactory degree of removal. These data are presented in Table 3. Several proportionate quantities of the activated carbon dosage were then used on the raw water in a two stage treatment. The most satisfactory result was obtained by treating the raw water with 50 mg per liter of activated carbon in the first stage. The filtrate of the latter stage was again treated with 50 mg per liter of the carbon. These data show that a two stage treatment of this water accomplished satisfactory treatment with half the original anticipated carbon dosage. This also implies that greater removal efficiencies may be predicted with the use of a carbon filter bed with a counter current flow system.

Table 2
Results of Test Runs on Carbon Filters Using Water from Shallow Well

Sample Number	Description of Sample	mg per liter as A. B. S.
1	Raw Water at Start	1.32
2	Treated Water 2nd. Gal.	0.02
3	Treated Water 5th. Gal.	0.03
4	Treated Water 10th. Gal.	0.05
5	Treated Water 15th. Gal.	0.07
6	Treated Water 20th. Gal.	0.12
7	Treated Water 25th. Gal.	0.10
8	Treated Water 30th. Gal.	0.13
9	Raw Water 30th. Gal.	1.36
10	Treated Water 35th. Gal.	0.10
11	Treated Water 40th. Gal.	0.10
12	Treated Water 45th. Gal.	0.15
13	Treated Water 50th. Gal.	0.16
14	Treated Water 55th. Gal.	0.15
15	Treated Water 60th. Gal.	0.15
16	Raw Water 60th. Gal.	1.36
17	Treated Water 65th. Gal.	0.15
18	Treated Water 70th. Gal.	0.21
19	Treated Water 75th. Gal.	0.18
20	Treated Water 80th. Gal.	0.34
21	Treated Water 85th. Gal.	0.30
22	Treated Water 90th. Gal.	0.30
23	Raw Water 90th. Gal.	1.40
24	Treated Water 95th. Gal.	0.28
25	Treated Water 100th. Gal.	0.30
26	Raw Water end of Run	1.40

PRACTICAL SIZE activated carbon column for home experiment.

Conclusions

Consideration should be given to the potential use of activated carbon for syndet removal for home and larger water treatment plants. The adsorption of syndets by activated carbon should also be considered to eliminate the foaming problem encountered in the aeration tanks of activated sludge plants. Other treatment plants would also be capable of producing a sewage effluent relatively free of detergents before their discharge into the fresh inland waterways.

Table 3
Two-Stage Activated Carbon Treatment

Raw Water plus mg per L Activated Carbon	Filtrate mg per L as A.B.S.
0	1.89
25	1.00
50	0.58
100	0.15
150	0.11
200	0.07
250	0.03
Successive Treatment	
50	0.39
50	0.06

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3. Flynn, J. M., Androli, A. and Guerrera, A. A., "Study of Synthetic Detergents in Ground Water," *Jour. A.W.W.A.*, Vol. 50, No. 12, (December, 1958) p. 1551.
4. Task Group Report, "Determination of Synthetic Detergent Constent of Raw Water Supplies," *Jour. A.W.W.A.*, Vol. 50, No. 10, (October, 1958) p. 1343.

Toronto Awards Outfall Sewer Contract

A $1,343,727 contract for construction of an outfall sewer for The Municipality of Metropolitan Toronto has been awarded to Dravo Construction Ltd. of Toronto.

Dravo's bid was the lowest of six submitted for the 10-foot diameter sewer which will empty treated effluent from the new Humber Sewage Treatment Plant into Lake Ontario near the mouth of the Humber River.

Consisting of subaqueous concrete pipe, the sewer will extend a distance of 2400 feet from a manhole at the land end. Approximately 600 feet of pipe will rest on filled land and the remainder will be set in a 20-foot-deep underwater trench, backfilled with crushed stone and material dredged from the lake bottom.

The outfall end, which will rest on prepacked concrete supports, will have 15 concrete outlets along a distance of approximately 350 feet. These will serve to diffuse the discharge.

The outfall was designed by James F. MacLaren Associates, Consulting Engineers, in association with Alvord, Burdick and Howson of Chicago, and its construction will be supervised by the MacLaren firm and the Metropolitan Toronto Department of Works under Commissioner R. L. Clark.

Control of remote facilities in Octopus-like system is solved by . . .

Supervisory Control In Johnstown, Penn.

by CURT E. OWEN
Asst. General Mgr.
Johnstown Water Company

RESUME: Solution of operating problems at Johnstown by installing centralized supervisory equipment has resulted in more dependable water service and savings in man-hours spent inspecting and checking. Utilizing telemetered flow, pressure and tank level data, one man operates valves and pumps remotely to control the complex system.

■ THE JOHNSTOWN WATER supply system is spread out over 38 square miles of hilly terrain, and manual control of the many elevated tanks, valves and pumps was very difficult. The system was kept under partial control by the time-consuming method of continual manual inspection. Because inspections could only be periodic, electrical and mechanical problems of valves and pumps could develop without immediate detection. If a valve did stick or a pump remained out of operation for very long, the section of the water system involved could be out of water. Many hours of work would be needed to bleed the line of air and place the section back in operation.

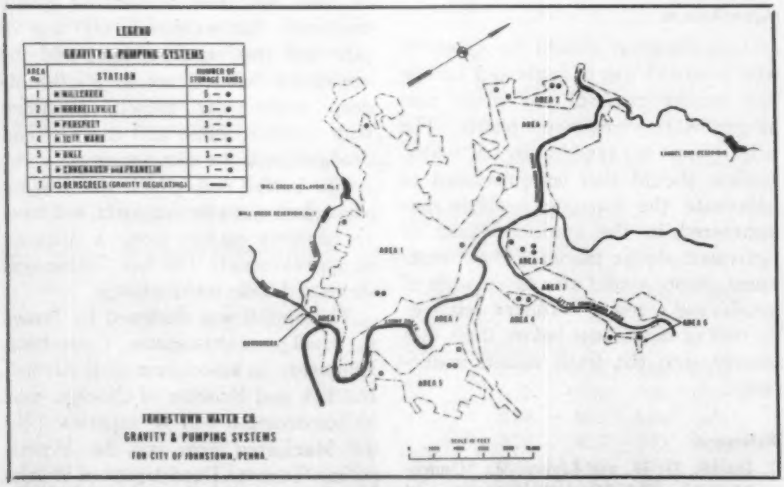
As the system enlarged, the possibility of system failures also enlarged; therefore, early in 1957, the Johnstown Water Company, in an effort to eliminate their system maintenance problems, seriously investigated the use of centralized control.

Historical Development of Johnstown, Pennsylvania

The City of Johnstown, Pennsylvania is situated in the Allegheny Mountains in the shape of a Y formed by the confluence of two rivers, the Stony Creek and Little Conemaugh, with hilly land not only along the outside of the Y, but coming down between the two branches. The chief industry is a plant of the Bethlehem Steel Corporation which stretches out for approximately nine miles on both sides of the Little Conemaugh River. The chief railroad, the main line of the Pennsylvania Railroad, approaches Johnstown through a gap formed by the base of the Y and follows the Conemaugh River straight through town.

In the old days, when a community water supply was first needed, some of the more progressive citizens formed a company and dammed up one of the mountain streams and piped the water from there into town simply by gravity. When the city grew to the point where additional supply was needed, another stream was dammed and more mountain water was fed in. This continued until, at the present time, Johnstown is supplied by five dams; three dams along the branch of the Y, one from the base of the Y, and the other from the other branch of the Y. While this was going on, the people in the city began to form communities on top of the hills in the outskirts of town, staying close to the town at first and expanding further back as time went on.

These residential sections turned out to be higher than the dams; consequently, pumping was necessary. As one hill was settled, a pumping station was built, a tank was erected, and the people were supplied with water. Continual growth and the migration of people to the hills went on until the Johnstown Water Company consisted of the five abovementioned dams, six different pumping stations, sixteen tanks—in many cases one being fed from the other—



OVERALL MAP of Johnstown, Pa. showing major station locations.

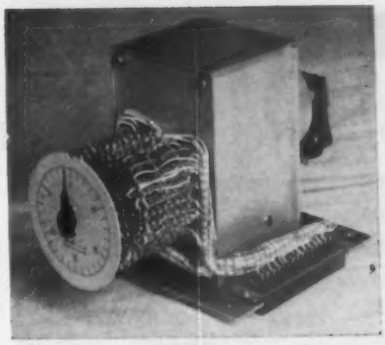
and twenty pressure reducing valves. Fig 1. The Johnstown Water Company not only supplies the City of Johnstown, but all or part of thirteen additional residential sections. One can see from this that, although the company is not particularly large, it is built somewhat similar to an octopus, going out in many directions.

The company supplies 25,000 consumers with approximately 13,000,000 gallons of water per day. The industrial consumers are fed mostly by gravity, and although 40 per cent of the consumers are on one pumping system or another, it is necessary to pump at the most 2,500,000 gallons of water per day. The hilly terrain causes parts of the central part of the city to be as low as 1,100 feet in elevation, the dams between 1,400 and 1,500 feet in elevation, and some of the residential sections as high as 1,900 feet in elevation. The stations, as the crow flies, are perhaps not farther than seven miles in distance, but it is quite often necessary to travel twenty-five miles to get there. The water system covers an area of 38 square miles.

Before the inauguration of centralized control, it was necessary to check the pumps and valves daily; and the tanks at least once a week, if not more often. Many of these are in locations which are very hard to reach, especially in winter weather. Then too, as mentioned before, altitude valves and pressure regulators had a bad habit of ceasing to operate several hours after having been checked. How much time was spent in this checking procedure, and how much time was spent in bleeding air from the lines because one went dry, would be impossible to determine. Even worse, one cannot put a cost on disgruntled consumers. Supervisory control was an ideal method to regulate the requirements of this far-flung system.

Johnstown's Supervisory Control System

Because each water system is different, a particular engineering approach to supervisory control is required. B-I-F Industries, Inc., was selected to give this system-package because they offered custom engineering, manufacturing and service which best suited the Johnstown situation.



SCANNING switch of the type used at Johnstown. Master switch is located in central control station panel and slave switches operate synchronously at each remote station.

Of the three different types of control equipment available offering the most economical and reliable method to control and telemeter the information for each supervisory control system, the simplest form is "two-function", which allows two signals, either control or telemetering, to be sent simultaneously in the same or opposite directions. This equipment is used primarily when a leg of the system warrants only two signals, such as "on-off" control and report back of an isolated pump.

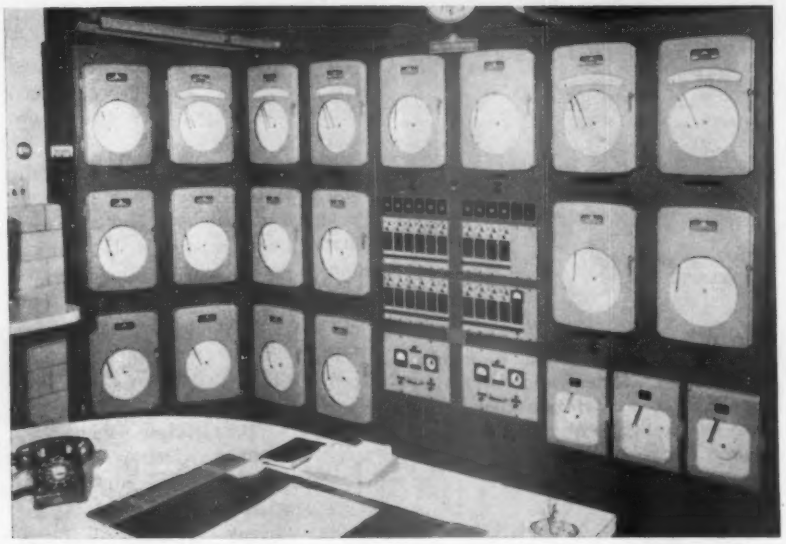
The next type is "transistor audio tone," employed for transmitting a large number of functions of control or telemetering simultaneously over the same transmission link. This is more applicable where the functions are spread out radially or in a long line. The absence or presence of a fixed tone frequency (normally between 300 cycles per second and 3,000 cycles per second) constitutes control or a time-impulse method of telemetering.

The third type is "intermittent scanning," applied where a large number of control functions are to be performed within a common area. The signals used on the transmission line are transistor audio-tone; however, the scanning switch allows the large number of control functions with a minimum of tone frequencies.

After an engineering study, intermittent scanning was recommended for the Johnstown application, together with a tone channel for each telemetered function. The transmission link between the central and remote stations, in this case, is a leased telephone line. However, the signals can be transmitted over private wires, micro-wave, carrier or radio bands, as well as the leased telephone lines. The use of each again depends upon the specific application.

The heart of the intermittent scanning system is the scanning switch, one at the dispatching end and each controlled remote station. If a remote pump is to be started, the operator turns a selector switch to "on." This creates a disagreement with the existing conditions and starts turning the scanning switches, Fig 2. As they turn, they pass over control and reportback contacts, and when they reach the contact which is linked to the pump switch "on", the control tone frequency is transmitted. At the remote station, a slave scanning switch turns in sychronization with the master scanner, and as the proper contact is reached, the transmitted control tone is received and the pump is turned on. A separate contact of the scanning switch reports back the operation of the pump through a different tone. Once the pump is reported back "on", the disagreement light goes off and the scanning switch comes to zero position and stops. Basically, fourteen controlled devices, turning a pump on or off, or opening or closing a valve, can be controlled by a scanning system in one revolution. In addition to control and telemetering, power failure and other alarm monitoring information are also reported to the central station.

The control switches are all of the plug-in type, making replacement quite easy. All the relays in the system are also plug-in and interchangeable. The entire audio-tone circuit is transistorized, which makes the units very compact and eliminates warm-up and heat dissipation problems. One valuable feature of this type of equipment is the use of intermittent scanning, whereby there are no moving parts except when a disagreement occurs, either by direction from the dispatching end or a fault at the remote end. The operation of the pump and valve switches can be either manual or automatically linked to some telemetered data, such as tank level or line pressure. All telemetering is simultaneously transmitted over the same link because different frequencies are assigned to each telemeter function.



SUPERVISORY control panel installed in Benscreek gravity regulating station. Recorders may be seen surrounding the various function control switches.

Supervisory Control at Johnstown, Pennsylvania

The system to be controlled at Johnstown consists of six pumping stations (Franklin, Morrellville, Dale, Millcreek, Tenth Ward and Prospect) and sixteen elevated tanks (Franklin, Morrellville, Tenth Ward, Dale, Roxbury, Millcreek, Prospect and Moxham), see system map, Fig 1. This system is all controlled from the panel shown in Figure 3, located in the Benscreek Regulating Station. Thirty separate pieces of information are telemetered to this board: five flows, sixteen pressures, and nine tank levels. In addition, ten pumps can be turned on or off, ten valves can be opened or closed, one valve controlled and its position indicated, all from the central control point. Finally, each pump has its total running time recorded, all tank level meters have a high level alarm, all six pumping stations have a power failure light, and there is an alarm silencer push button. It is easily seen how one man could completely control this system from this centralized point.

In Figure 3, ten pump controls are in the top row in the center section, the corresponding level valve controls are in the second or bottom row. Each of the six pumping stations has two pumps and two valves to control. Room for three future controls is available. This installation has two scanning systems—the left one controls the six pumps and six valves at the Morrellville, Dale and Millcreek stations, while the right one controls the four pumps and four valves at the Prospect and Franklin stations.

Summary

The use of transistor tone and synchronized scanning equipment made possible a centralized control station from which the different pump stations could be remotely operated. It made possible the transmitting of different tank levels to this one location, and it has made possible the transmitting of pressure showing whether reducing valves are working or not. Having this information in one central point has enabled the water company to claim that not one section has been out of water or dangerously low since its installation. It is calculated that savings will pay for the equipment, plus the total installation cost, in less than three years. The time saved in checking, and increased good will of the consumers, is all gravy—how rich will never be known. A completely integrated system from one manufacturer was definitely advantageous in this job application.

Walker Becomes New Orsanco Chairman

Ross H. Walker of Richmond, Va., an eminent conservationist, took office on July 1, as chairman of the Ohio River Valley Water Sanitation Commission. He Succeeds Maurice E. Gosnell, an attorney from Lawrenceville, Ill.

Mr. Walker has been a Virginia commissioner on the interstate agency since its establishment in 1948. He is also a member of the Virginia State Water Control Board, on which he has served for fifteen years in developing safeguards for water resources.

Looking to the year ahead when Commission affairs will be under his leadership, Mr. Walker said: "Our regional pollution-abatement program has done much to restore streams to a cleaner condition. Waste control facilities are now provided for eight out of ten people and for eighty per cent of the industries. Since the majority of communities and industries have met their obligation to curb pollution, we cannot tolerate further delay by those who have not done their part. Accordingly, when the eight states meet in September, they will review the status of delinquent municipalities and industries and determine appropriate enforcement action."

He also stated that developmental work on a "robot monitor" is almost completed. "Before the end of the year, automatic devices will be in operation to provide a continuous check on river quality conditions. These will provide our eight states with a unique system for pollution control surveillance that has never before been attempted."

Jamaica Water Supply Honored by U.S. Treasury

A special United States Treasury Department award honoring the Jamaica Water Supply Company for outstanding service to the Savings Bond Program was presented June 20, to Gerard J. Dierker, president of the utility.

The citation, signed by Treasury Secretary Robert B. Anderson, was awarded in appreciation of the water company's "patriotic service to the Nation." The company had distributed 125,000 leaflets to its customers each year as bill enclosures resulting "in a valuable contribution to the sale of Saving Bonds in the Long Island area." Jamaica Water Supply serves a population of more than 600,000 in Eastern Queens and Western Nassau.

The fundamentals are presented of the theory and applications of . . .

ORP Measurement in Waste Treatment*

by T. J. KEHOE and R. H. JONES
Applications Engineering Department
Beckman Instruments, Inc.
Fullerton, Calif.

EDITOR'S NOTE: One of the more poorly understood and yet potentially useful determinations available to the waste treatment field is that for oxidation reduction potential (ORP). This measurement can be used for almost anything from sewage odor control to complete operation of an activated sludge plant. One major factor in the lack of understanding is the absence of a universally accepted convention for signs. The effect of this particular difference can easily be seen when it is appreciated that the sign for a given reaction potential in the handbook will be the opposite of that measured on an instrument when used with the same materials.

■ MANY INDUSTRIAL and all domestic wastes undergo chemical change from the point of origin to final disposal. This change usually consists of biological reduction, coupled with, but opposing some form of oxidation. In addition, deliberate oxidation or reduction processes are sometimes inserted to bring about an exceptable end product.

A waste rich in organic matter will decompose rapidly if the pH, temperature, and other variables involved permit. It could also be stated that such a waste rapidly becomes reduced. Conversely, this waste exposed to adequate aeration or strong chemical oxidants will be oxidized and will display chemical and physical characteristics completely unlike the reduced material. Activated sludge processes and oxidation ponds take advantage of the fact that organic wastes can be broken down into harmless inorganic chemicals by the proper maintenance of biological activity in conjunction with the introduction of oxygen. The source of the oxygen will depend on the process involved whether it be by chemical addition, algal growth, aeration, etc.

With inorganic chemical wastes certain toxic or unwanted compounds can be oxidized or reduced by the controlled addition of opposing reducing or oxidizing agents to produce harmless products.

A bibliography outlining the numerous processes and methods that already have been developed on this subject would indeed be a lengthy one. It can be stated on a qualified basis that each and every process, involving oxidation-reduction, can be analytically monitored by means of continuous ORP measurement. The qualifications sometimes required, however, tend to negate the practicality of some applications. In fact, the seemingly broad gap between that which theoretically can be done and what is realistically possible and practical represents the subject of this discussion. The usefulness of the measurement can only be evaluated by an understanding of its principles and limitations.

The Principles of ORP Measurement

Generally speaking, all chemical reactions involving an exchange of electrons are considered to be oxidation-reduction reactions. The relative strengths of the oxidant and reductant involved can be measured by determining the oxidation-reduction potential prevailing. This can be done by inserting an unattackable electrode, such as platinum, rhodium, etc., into the solution together with a constant voltage reference electrode and measuring the resulting emf by means of a high impedance potentiometer or similar device. The emf or voltage measured is the difference between the individual potentials developed at each electrode. If the reference electrode is a hydrogen gas electrode, the potential developed at the measuring electrode by convention can be considered the true potential of the oxidation-reduction reaction being measured. If a calomel or silver-silver chloride reference electrode or any other is employed, a correction factor must be incorporated. The details of this aspect will be discussed separately later in this paper.

The significance of this measurement relies on the fact that all compounds or materials that can exchange electrons develop specific potentials of a higher or lower magnitude than the arbitrary reference, namely, hydrogen. The following Table 1 illustrates some of the standard oxidation-reduction potentials that are pertinent to this discussion.[1] The values, in volts, referred to the Hydrogen-Hydrogen Ion Couple at zero volts are for Unit Activities and Temperature of 25°C. Designed as E_o, they can be inserted into the general form of the Nernst equation. To best understand the relationship between a measured ORP one might observe and the potential E_o that prevails under the terms of Table 1, the general form of the Nernst equation should be examined:

*This paper was originally presented before the Symposium on Industrial Wastes presented by the Division of Water and Waste Chemistry of the American Chemical Society at its 137th National Meeting in Cleveland April 11 and 12, 1960 and is printed here with the permission of ACS.

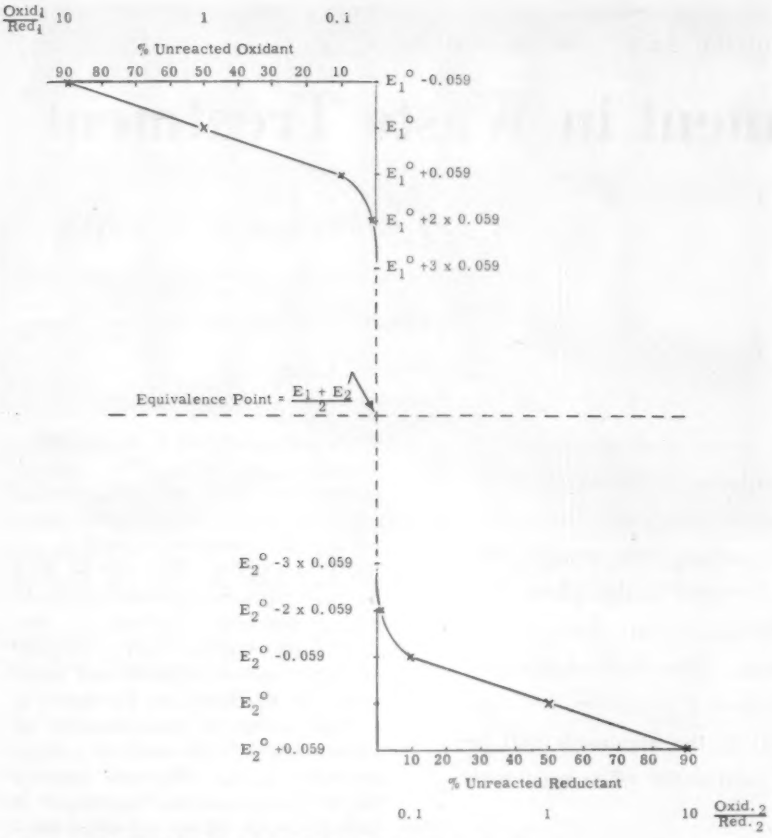


FIG 1. GENERALIZED POTENTIOMETER Titration Curve

$$E = E_o - \frac{0.0591}{n} \log \frac{\text{oxidant}}{\text{reductant}}$$

E = The measured emf expressed in volts opposed to the normal hydrogen electrode whose potential is zero.

E_o = The standard emf as found in the preceeding table and under the conditions as specified.

n = Number of electrons or electron equivalents involved in the reaction.

Table 1
Potentials of Solutions at Unit Activity*

	E_o, volts
$CN^- + 2OH^- = CNO^- + H_2O + 2E^-$	+0.97
$Fe + 2OH^- = Fe(OH)_2 + 2E^-$	+0.86
$Fe(OH)_2 + OH^- = Fe(OH)_3 + E^-$	+0.65
$Cr = Cr^{++} + 2E^-$	+0.6
$S^{--} = S + 2E^-$	+0.51
$Fe = Fe^{++} + 2E^-$	+0.44
$Cr^{++} = Cr^{+++} + E^-$	+0.4
$H_2 = 2H^+ + 2E^-$	0.000
$HCN + H_2O = HCNO + 2H^+ + 2E^-$	0.0
$H_2S = S + 2H^+ + 2E^-$	−0.17
$S + 3H_2O = H_2SO_3 + 4H^+ + 2E^-$	−0.47
$Fe^{++} = Fe^{+++} + E^-$	−0.74
$2Cl^- = Cl_2 + 2E^-$	−1.359
$Cl^- + H_2O = HClO + H^+ + 2E^-$	−1.50

*Related to Hydrogen—Hydrogen Ion Couple at IATM and 25°C

From the above one can predict the expected potential depending upon the ratio of oxidant and reductant. The actual concentration of either oxidant or reductant cannot be determined by the electrode potential alone. This is a condition similar to pH measurement wherein the total acidity or alkalinity cannot be determined by the pH value alone. In both cases, a titration must be performed to quantitatively analyze the solution. Figure 1[2] illustrates the voltage change as an oxidant (Ox_1) is reduced by a reductant (Red_2) until an excess of reductant appears according to the following equation and applying the Nernst equation:

Sign Conventions in Electrochemistry

To understand and properly interpret the equations and handbook data on this subject, it is necessary to appreciate the rather confusing sign conventions that exist.

To designate the sign of the potential at a single electrode or half-cell potential, a universal convention has not yet been adopted. There are two systems which appear to be completely opposite and are referred to as the American Convention and the European Convention. The American Convention is illustrated in the previous Table 1. Here the sign of the potential is the true polarity of the solution surrounding the measuring electrode and not the opposite sign of the electrode itself. Instrument makers and many users are only concerned with the sign of the electrode since the meter is only aware of this polarity. Thus, most millivolt meters read out in signs following the European Convention.

The electrode potential by the European Convention becomes more negative as the agent becomes a more effective reductant than hydrogen and more positive if the agent is a more effective oxidant.

In expressing a complete cell reaction it has been generally agreed[3] that the emf is given a positive sign if the electrode on the left of the scheme is negative and that on the right is positive. Also, the cell reaction is always written as if oxidation always occurred at the left electrode and reduction at the right. Thus, a positive emf denotes that the cell reaction proceeds from left to right and a negative one in the reverse direction.

Reference Electrode Potential Corrections

The complete cell reaction potential includes the potential at or on the measuring electrode, the purpose of the measurement, together with the potential of the reference electrode.

Most data assumes that the reference is a hydrogen electrode in which case this potential arbitrarily is zero at all temperatures thus is of no concern. On the other hand, all ORP measurements employ either a calomel or silver-silver chloride electrode as a reference. Thus, a correction factor must be applied to the potential indicated on the meter to make the reading conform to handbook values.

This can be expressed by the following equation:

Eh = E + voltage of reference electrode

where Eh = The potential with reference to the hydrogen electrode

E = Observed voltage with calomel or silver-silver chloride

Potential of standard calomel reference electrode (with sat. KCl @ 25°C — European Conv.) +0.244 volts

Potential of silver-silver chloride reference electrode (with 4M KCl @ 25°C — European Conv.)	+0.199 volts
Potential of standard hydrogen electrode	0.00 volts

For example, if the saturated calomel electrode is used as the reference electrode, and the measured voltage E is 400 mv. Eh = 400 + 244 = 644 mv at 25°C (voltage of saturated calomel electrode is 244.3 mv at 25°C). If the measured value E is −544 mv then Eh = 544 + 244 = −300 mv at 25°C. It can be seen that the Eh of an oxidation-reduction system will always differ from the measured value E by the voltage difference between the reference electrode being used and a normal hydrogen electrode. The values given will be opposite to the signs appearing in the handbook. The same type of correction would apply if the silver-silver chloride electrode were employed in place of the calomel but differing by 45 millivolts (@ 25°C).

Limitations of ORP Measurement

From the preceeding it would appear that this method of measurement offers a positive means of controlling numerous reactions. In part, this is true. On the other hand, it is rare that domestic or individual wastes are simple wastes in respect to the organic and/or inorganic chemicals usually present.

In most cases, a platinum surface forms the measuring electrode in an ORP cell. The limitations of this electrode can include the following: 1) It can be influenced by all oxidants and reductants present. 2) The surface can become mechanically coated to desensitize its performance. 3) The surface can exhibit a memory effect by exposure to strong oxidants or reductants with subsequent residual influence, 4) The pH of the solution influences the net potential measured. Figure 2 illustrates the sizeable influence of pH as it appears in the classical hexavalent chromium reduction, 5) The temperature of the solution influences the potential but only slightly. The necessary correction will usually be less than 1 millivolt per degree centigrade. This value varies with the electrode being used. Temperature is much more significant as it affects the oxidation-reduction reaction rate since in most processes reaction rates accelerate with increasing temperature.

The influence of other oxidants and reductants, particularly in wastes, cannot be ignored. It would be extremely difficult if not impossible to account for and assess all of the oxidants and reductants found in domestic sewage as it reaches a treatment plant. Correlation between chlorination of treatment plant influent by ORP measurement and odor control through the plant offers interesting possibilities. The authors evaluated this method at several California treatment plants. It was found that sub-residual chlorination, to boost the ORP of the sewage to a slightly positive level assured odor-free operation. Depending upon pH, time of day, age, climate, etc., the incoming sewage had ORP levels ranging from −300 to +100 mv. Such a range is similar to that found by Eckenfelder and Hood[4], Eliassen[5], Grune et al.[6], and others. For those concerned, it is recommended that this work of Grune et al.[6] be reviewed in detail to appreciate the significance of ORP within sewage treatment processes. Eckenfelder and Hood[4] present data illustrating the influence of pH on the ORP of various industrial wastes. They also point out the complexity of organic wastes and the variables that must be considered to obtain reliable information from an ORP measurement. Figure 3 from their work illustrates the general correlation of ORP to influence steps taken through a waste treatment plant. The wastes consisted of antibiotics in conjunction with domestic sewage.

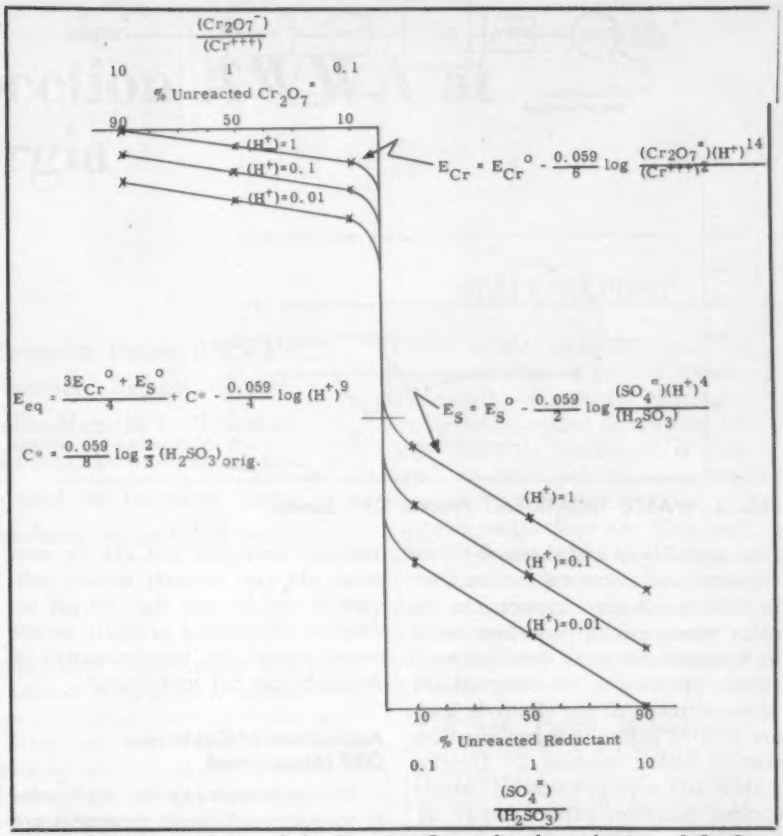


FIG 2. GENERAL FORM of the Titration Curve for the reduction of $Cr_2O_7^{=}$ with SO_2

Calibration of an ORP System

It is frequently suggested that some means be established to calibrate or standardize an ORP system. Unfortunately, because of the complexity of most measurements from the standpoint of multiplicity of variables, such a procedure might cause more harm than good. Also, mention was made earlier of memory or poisoning effects. In a continuous measurement, a platinum electrode can only measure the potential prevailing. It cannot deceive unless the surface becomes coated or ORP levels shift rapidly to introduce the memory problem. Taking an electrode pair from a stream and placing it into a beaker containing a "standard" ORP solu-

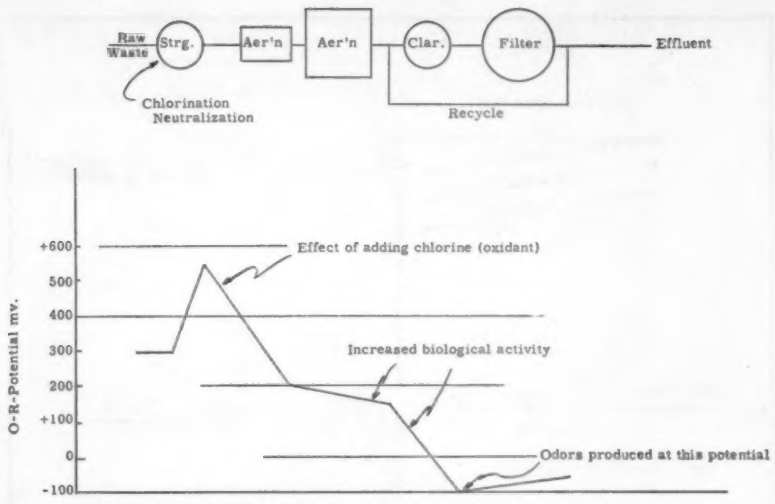


FIG. 3. WASTE TREATMENT Process ORP Survey.

tion, probably of completely different character and concentration, may not provide the desired answer. On the other hand, such a procedure might be adequate for some installations if certain precautions are observed: 1) Make certain that the electrode leads are shorted before withdrawing from contact with a solution, 2) Develop a rinse and wipe procedure to assure a clean platinum surface before attempting to calibrate. The extent of this step will depend upon the nature of the stream and electrode condition upon removal, 3) Calibrate in two "standard" solutions making sure that a non-drifting final measurement is attained.

The most frequently suggested solutions for checking the electrodes consist of quinhydrone in buffers. The potential of a quinhydrone solution in 4.0 and 7.0 pH buffer may be calculated. The solutions can be prepared simply by adding a few grams of quinhydrone to standard buffer solution. The solutions should be prepared fresh for each use. Values are given in Table 2 for the temperatures 20, 25, and 30°C are for the calomel, silver-silver chloride, and hydrogen reference electrodes in both buffers. These readings in Table 2 are European Convention and are the ones most pH and millivolt meters indicate. It can be seen that the pH influences the reading precisely as one would expect, i.e., approximately 59 millivolts per pH unit change.

Applications of Continuous ORP Measurement

The applications as they apply solely to waste and waste treatment are numerous. As already discussed, the practicality of each application must be closely scrutinized and will depend upon the need, interferences, maintenance problems, etc. There are excellent references that discuss the ORP applications in sewage treatment plants. A few of these references already have been cited. The most interesting of this group of applications involve the following: 1) Treatment plant odor control, 2) Aeration control sludge processes, 3) Digester monitoring, 4) Influent monitoring to detect unwanted industrial waste reductants or oxidants.

In the area of industrial waste treatment, the two most significant processes that practically demand employment of ORP are the cyanide oxidation and the hexavalent chromate reduction processes.

In the general field of inorganic chemical wastes, there are a variety of specialized wastes where unwanted oxidants or reductants are involved.

In the food, pharmaceutical, diary, and organic chemical industries, a general application exists primarily concerning high BOD organic wastes. The limitations and problems already discussed regarding sewage applications apply here as well. A great amount of study has been made in the pharmaceutical industry. Here, their problems are magnified since the nature of some of their wastes can retard or kill the biological oxidation or reduction processes necessary for proper waste treatment either at the source or in domestic treatment plants. ORP measurement can serve to assure that the optimum conditions are maintained.

Summary

In conclusion, it is urged that those directly concerned with this measurement condense the basic information on this subject into an understandable form for direct use. Much of the confusion regarding ORP concerns the sign convention. The limitations of the measurement must be recognized and each application and/or installation must be investigated with this in mind. A means of attaining reliability assurance must be established. Checking the electrode pair against quinhydrone solutions is one measure that can be employed. The ORP measurement is influenced by all oxidants and reductants. Thus, it is rare that this measurement can be considered a specific measurement. As a result high measurement accuracy cannot be expected. ORP is not quantitative measurement but only conveys oxidation-reduction ratios. The applications generally concern organic wastes of an industrial or domestic nature.

Table 2

ORP of Quinhydrone Solutions

	pH 4			pH 7		
Temperature, °C	20°	25°	30°	20°	25°	30°
Calomel	223	218	213	47	41	34
Silver-Silver Chloride	268	263	258	92	86	79
Hydrogen	470	462	454	295	285	275

References

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3 Bates, R. G., *Electrometric pH Determinations*, John Wiley and Sons, Inc. New York 1954.
4 Eckenfelder, W. W. Jr., and Hood, J. W., p. 221, *Proc. of the Sixth Ind. Waste Conf.*, Purdue Univ., 1951.
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Thirty-First Annual Meeting . . .

Southeastern Section AWWA at Savannah, Georgia

STAFF REPORT

RESUME: An evaluation of the Southeastern section AWWA's water utilities was featured at this meeting. Reports of self-examination using the guides in Johns-Manville's "Priceless Water" were presented from fifteen utilities. Down-to-earth, the evaluation points up emphatically the need for increased attention to all aspects of water supply. Attendance totalled 368 members and guests.

■ **The Savannah Industrial & Domestic Water Supply** was described by C. T. Wise, J. E. Sirrine Company, consulting engineers, Greenville, South Carolina. Savannah's water supply program was recently expanded due to growth in local industries, particularly in water requirements for the pulp and paper manufacturers. Pre-World War II planning indicated the possibility of salt water encroachment in the ground water supply and this led to the consideration of two surface water supply sources. The Ogeechee River is located twelve to thirteen miles from Savannah and has comparatively high color. The Savannah River was selected as a source for recommendation for a 40 mgd treatment plant. Following World War II, plant construction was initiated on Abercorn Creek, fifteen miles from Savannah. Initial construction was a raw water pump station located eight miles from the water treatment plant site. At this location, a six foot tidal variation contributes to a variation in water quality, requiring close attention to control of liquid alum and dehydrated lime at the treatment plant located on Cherokee Hill. This site, 50 feet above sea level permits ground level storage and gravity flow to the city. As initially constructed, the plant provided for feeding liquid alum, hydrated lime and chlorine in a conventional flocculation sedimentation tank, eight double filters and a 3 mg wet well. In 1953, storage capacity was increased by the addition of the 10 mg reservoir 240 feet in diameter and 32 feet high.

In 1956, a 10 mgd raw water booster station was constructed to increase raw water delivery to the treatment plant. Also additional flash mixing was installed to facilitate mixing chemicals. At the same time, the settling basin outlet weirs were raised to provide increased retention at the 50 mgd rate.

Salt Water Incroachment into the principal artesian aquifer in the Savannah area was described by Harlen B. Counts, USGS, Savannah, Georgia. Original ground water supply in the southeastern United States has been of good quality, even temperature and ample capacity. Salt water encroachment is a possibility due to lowering of the water table and led to investigations beginning in 1954 when two test wells up to 1400 feet deep were drilled. In 1958, a third test well was provided and helped to define the depth and lateral distance of the aquifer. The aquifer has a natural outlet fifteen miles northeast of Savannah; however, the artesian head has declined as a result of increased ground water pumpage and the greatest decline in central Savannah. Study of samples from the test wells show that dangerous advance towards Savannah is estimated to be a century away at present withdrawal rates.

Recommendations are that well fields be dispursed and recharge of ground water be made wherever possible. Surface water use should be continued and further study of the ground water problem should be made.

Well and Pump Maintenance was discussed by Paul Schweitzer, Layne-Atlantic Company, Norfolk, Virginia. The major portions of deep well pumps cannot be observed critically, with only the operating head and prime mover normally visible. Frequency of submerged portions of pumps inspection depends on many factors, the amount of lime, total hardness, pH, presence of sulfide, materials of construction, speed of operation and amount of use per day. Records, including dates of construction and maintenance records and maintenance dates, should be included in the case history of each well. The maintenance program should be regulated to minimize failures which always happen at the most inconvenient times. Well equipment should include production meters, static level gauge, draw down measurement together with correct data interpretation.

Water Utility's Evaluation, advancement committee report, moderated by M. E. Henley, Wallace & Tiernan, Atlanta, Georgia. Use of "Priceless Water" booklet issued by Johns-Manville was used as a guide in studying the fifteen southeastern U. S. water utilities, according to S. H. Painter, Johns-Manville, New York, New York.

The booklet is intended to assist in working with "city hall" people and to organize information in pointing out needs in promoting a program of water utility improvements. The matter of water supply was discussed by W. R. Wise, Public Works Commission, Greenwood, South Carolina. Deficencies were noted in peak hour demands, and reliable supply intakes. He emphasized the necessity for an adequate source of good quality water and the need for the public to be informed.

A report on treatment was given by Dr. P. J. Philson, Columbia, South Carolina. Popular press articles are tending to make the public more aware of water supply and treatment problems. He suggested a plot of the average peak day demand over an extended period, and to determine how each link of the utility stands up to requirements. Of the fifteen reporting on treatment, nine were deficient in treatment, four deficient in reliability, two deficient in quality and reasonably good in chemical quality and personnel.

Distribution System Evaluation was discussed by W. H. Weaver, DeKalb County Water System, Decatur, Georgia who indicated his system needs fifty-four per cent of the suggested distribution system requirements. Study shows inadequate loops in the distribution system. Progress is being made with respect to metering in the DeKalb system with 55,000 meters installed by the end of 1957 and 85% accounted for water.

Metering was discussed by A. M. Johnstone, Orangeburg, South Carolina, who reported that approximately half of the responses indicated deficiencies in this section of the evaluation.

Effect of "Hurricane Gracie" on South Carolina Water Utilities was discussed by J. W. Logan, Jr. of Beaufort, South Carolina. Sufficient warning was provided about the approach of hurricane Gracie to permit checking out of emergency and standby units together with other preparations. The Beaufort system has nine wells which were all knocked out as the result of the 125-135 mph winds during the peak of the hurricane. All elevated tanks were cut out, providing maximum weight to resist the wind. Standby units were not started until the first high winds had gone through the area. Luckily, no water mains were torn out by uprooting trees and there were no fires during the emergency period. Generators were borrowed from the U.S. Marine Corps. Station at Parris Island as well as from the health department and civil defense organizations. It was emphasized that extra emergency equipment such as generators are similar to an insurance policy, particularly in times when so much equipment is rendered inactive.

Emergency Equipment Availability was discussed by Mr. Joseph Boyer, acting director of health Mobilization. Ice storms during early 1960 indicated the value of emergency equipment and a civil defense provision makes supplies, equipment and personnel available to local communities. The primary objective is to stockpile medical supplies and pool medical personnel for emergency purposes. The federal contributions program for emergencies and training has been in effect for one-and-a-half years. Under this program, subject to the approval of state directors of civil defense matching funds are provided by Congress for the purchase of supplies and equipment necessary for a balanced, adequate civil defense program. The Office of Civil and Defense Mobilization Contributions Manual, AM-25-1, lists engineering and laboratory equipment that may be purchased on a 50% matching funds basis for water plant use in training and emergencies. Requests for purchase, with justification, must be attached to a project application, form 223 (annex 2A) obtained from state civil defense directors. Among items included are chlorinators, hypochlorinators, centrifugal pumps, generator sets, membrane filter equipment, chlorine test kits, and radiological survey meters.

Salt Water Conversion Discussed in Pamphlet

Prompted by the "serious and growing shortage of fresh water in the United States and the desperate need for fresh water in many arid, newly-developing countries abroad," the Research and Education Committee For a Free World has published a 23-page pamphlet entitled, "The Facts About Salt Water Conversion."

The publication discusses the need for increasing our supply of fresh water, examining our present resources, and requirements and those expected as our population increases in the future. An explanation of salt water conversion and the prevailing methods of conversion is presented as well as a list of the presently operating conversion plants.

The pamphlet's concluding chapter discusses the Government's Office of Saline Water, its program and needs.

Promoting the expansion of activities in the salt water conversion area, the publication presents the "facts" in a straightforward, question-and-answer manner.

George A. Kendall Dies

George Arthur Kendall, president, general manager and director of Southern California's Palos Verdes Water Company, died June 8, at the age of 54. He had been president of the company since 1954 and was also a director and consultant for the Diamond Bar Water Company.

Mr. Kendall was a member of the A.W.W.A. and a director of both the California Water Assn. and the West Basin Water Assn.

Hopkins Receives PHS Water and Pollution Post

Surgeon General Leroy E. Burney has announced the appointment of Sanitary Engineer Director, O. C. Hopkins, as Deputy Chief of the Public Health Service's Division of Water Supply and Pollution Control.

Mr. Hopkins, a career officer in the PHS, succeeds Arve H. Dahl who has been assigned to a year's tour of duty and training at the Industrial College of the Armed Forces in Washington.

Since 1925, Hopkins has been engaged in environmental sanitation work with the PHS and from 1955-57, he was chief public health engineer advisor to the Indian Ministry of Health in New Delhi, helping to organize the public health engineering division of the Indian Government.

RESEARCH PROGRESS REPORT

A W&S Research Progress Report describing . . .

Oligochaetes As Indicators of Pollution

By CLARENCE J. GOODNIGHT
and L. S. WHITLEY
Dept. of Biological Science,
Purdue University

RESUME: Abundance of Oligochaetes in polluted stream bottoms has led to a study designed to produce a rapid biological indicator of pollution. This report describes progress to date and direction in which research is progressing.

■ THE NEED FOR a fast, simple biological indicator for stream pollution has long been recognized. Several methods have been explored, and while all are valuable, most were found to involve complicated taxonomic problems. At the present time, we are investigating a system which may meet the standards desired without the usual identification problems.

At first observation in a polluted area, the bottom often appears to be a dull red color. This color is due to the presence of thousands of oligochaetes, small aquatic annelid worms, of the family Tubificidae. So often are these worms associated with pollution that they have obtained various common names such as "sewer worms", and "sludge worms". It has come to our attention that the abundance of these worms in relation to the total bottom fauna might provide a system for the recognition of the degree of pollution in streams or drainage ditches.

In investigating this phenomena a drainage ditch southeast of Lafayette, Indiana, was selected for study. This ditch is of average size, and has the important characteristic of having relatively clean stretches of water as well as areas of domestic and industrial pollution.

The study being made consists of determining the physical and chemical characteristics of the ditch water and includes such measurements as the amount of dissolved oxygen, carbon dioxide free in the water, coliform analysis, total hardness, calcium hardness, pH and B.O.D. These factors have been determined at each of seven stations along the ditch. Samples have been collected weekly from June to November, 1959, and bimonthly from the first of November until the present time (March, 1960). The collections will be continued until July, 1960. We feel that these determinations will give us a fairly complete picture of the water characteristics of the ditch in all seven areas.

In conjunction with these limnological samples, samples of the bottom fauna at each of the seven stations have been taken in the field and brought into the laboratory. The same collection periods were used, both water and bottom samples taken at the same time. In the laboratory, the bottom samples are rinsed through four standard sieves to remove mud and sand. These sieves are then set into pans of water and the bottom samples sorted by hand to remove all the fauna. Quantitative tabulations are kept on the forms and their abundance in the sample. The forms are then stored in preservative for future reference.

At the present time, this study has not progressed far enough to draw concrete conclusions. We do feel, however, that the possibilities are excellent that these worms may be used as the basis of a system which will allow a person with only a basic knowledge of biology and without special taxonomic training to take samples of a small stream or ditch and to determine whether or not polluted conditions exist.

In addition to the detailed study of this one ditch, samples are being taken in other streams throughout Indiana. This will provide a further check on the validity of the system for identifying polluted areas.

Colonies of these worms are also being raised in the laboratory so that investigations of the effects of various pollutant factors on their reproductive rate may be investigated.

This work is being done under a grant from the National Institutes of Health.

Digester operation might be better controlled with quick results from . . .

Gas Analysis by Chromatography

by W. L. HENDERSON, Research Analyst,
Orange County, Santa Ana, Calif.

EDITOR'S NOTE: Gas chromatography is a quick and reliable method for determining the quality of digester gas. The short 5 minute period required for complete gas analysis with this equipment could could make it a valuable tool in the control and operation of digestion processes of gas utilization facilities.

■ SINCE SLUDGE DIGESTION was first introduced as a major process in sewage and waste treatment there has been a search for better control tests. Initially, aside from observations of consistency, color and odor, the completeness of digestion was determined by analysis for fixed and volatile solids. pH measurements, made with color comparators after filtration or dilution of the sludge, were introduced in the late 1920's as an indication of the state of health of the digestion process. Still later methods of determining the concentration of organic acids, the "volatile acidity test", were introduced and generally found to be more sensitive to changes in the digestion process than the tests previously used.

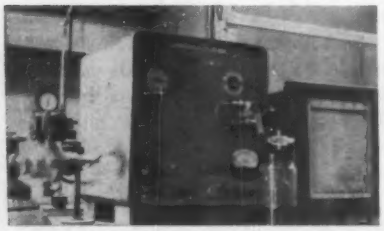


FIG. 1. GAS CHROMATOGRAPHY APPARATUS (L to R) Helium tank with pressure reducer and regulator, rotameter, chromatograph, and recorder. Sample is received from collection bottle through rubber tube at right side of chromatograph.

Most operators who have experienced trouble with sludge digestion have observed that a very early indication of trouble came through a change in the quantity or quality, or both, of the gas produced. Thus it has occurred to many that the analysis of the gas when compared with accurate records of gas production, provides a very sensitive control procedure. Unfortunately, the conventional methods for gas analysis by selective absorption and combustion apparatus has certain disadvantages. This apparatus is relatively complex and delicate, and requires a considerable degree of manipulative skill to operate. A complete analysis can require up to one hour. Finally, nitrogen is determined by difference, so that any and all errors will be in the nitrogen value.

Grune, Carter and Keenan, in 1956[1] described the use of a new method of gas analysis for following the progress of digestion in experimental digesters. This method, known as gas chromatography, is a relatively recent development, and provides an instrumental method for gas analysis. However, there seems to be very few applications of this method for routine digester control. Although the equipment is fairly costly, the time required for a complete gas analysis (nitrogen, methane, and carbon dioxide) is reduced to a matter of minutes. Other constituents appearing in small concentrations, such as hydrogen, ammonia, hydrogen sulphide, etc., can also be determined but are not so important in routine work.

Gas chromatography makes it practical to analyze samples of gas from a number of sludge digestion tanks daily. The time required for such gas

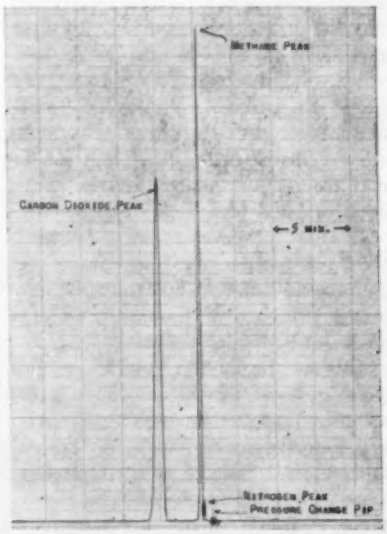


FIG. 2. RECORDED ANALYSIS of digester gas sample. The pressure dip (right) denotes introduction of the sample, then nitrogen came through, methane and finally carbon dioxide all in a matter of 3.5 minutes. The complete analysis should require no more than 4.5 minutes.

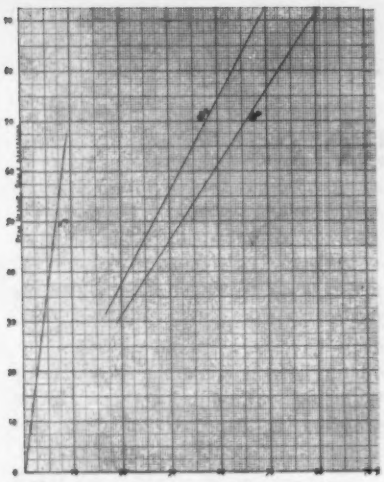


FIG. 3. CALIBRATION CURVE for gas chromatograph reflecting per cent concentration of nitrogen, carbon dioxide, and methane against peak height of curve for standard operating conditions.

analyses is less than for determinations of volatile acidity, and in addition there is no glassware to wash afterward.

This method of gas analysis has been in use in the laboratory of the County Sanitation Districts of Orange County, California, for about one year. The time required for the analysis of 7 samples per day is about 45 minutes. The procedure is also used extensively as a control test for experimental digesters. The chromatographic column in use is packed with silica gel, which cannot differentiate between oxygen, nitrogen, or mixtures of the two. This is not as serious as would at first appear, since normal digester gas will contain no oxygen, and only a few tenths of one per cent of nitrogen. If necessary other packing materials could be employed which would permit the separate determination of oxygen and nitrogen if this became desirable.

As stated, gas chromatography is an instrumental method. The sample is carried though the column by a stream of helium. Due to absorption phenomena, the various constituents of the sample pass through the column at different rates, and hence appear separately in the column effluent. At the end of the column the mixture of constituent and carrier gas pass through a thermal conductivity detector and produce electrical signals. These signals actuate a strip chart recorder, giving peaks for the various constituents. Figure 2 is a reproduction of the actual recorded trace from an analysis of digester gas. When quantitative results are desired, a calibration chart can be developed by plotting peak height against percentage for each constituent. Figure 3 is a copy of such a calibration chart. Care must be taken that samples are run under the same instrumental conditions (temperature, carrier gas flow rate, size of sample, detector voltage) as were used in making the calibration.

In Figure 4 the results of gas analysis for carbon dioxide and the results of volatile acidity determinations for a particular digester are plotted on the same graph. This shows the association between changes in the composition of the gas during changes in the status of the digestion process in the same way as do the determinations of volatile acidity. The carbon dioxide values often indicate a change in the process as much as 24 hours before the volatile acidity values.

References

1. Grune, W. N., Carter, J. V. Jr., and Keenan, J. P., *SEWAGE AND IND WASTES*, 28, 1433 (1956).

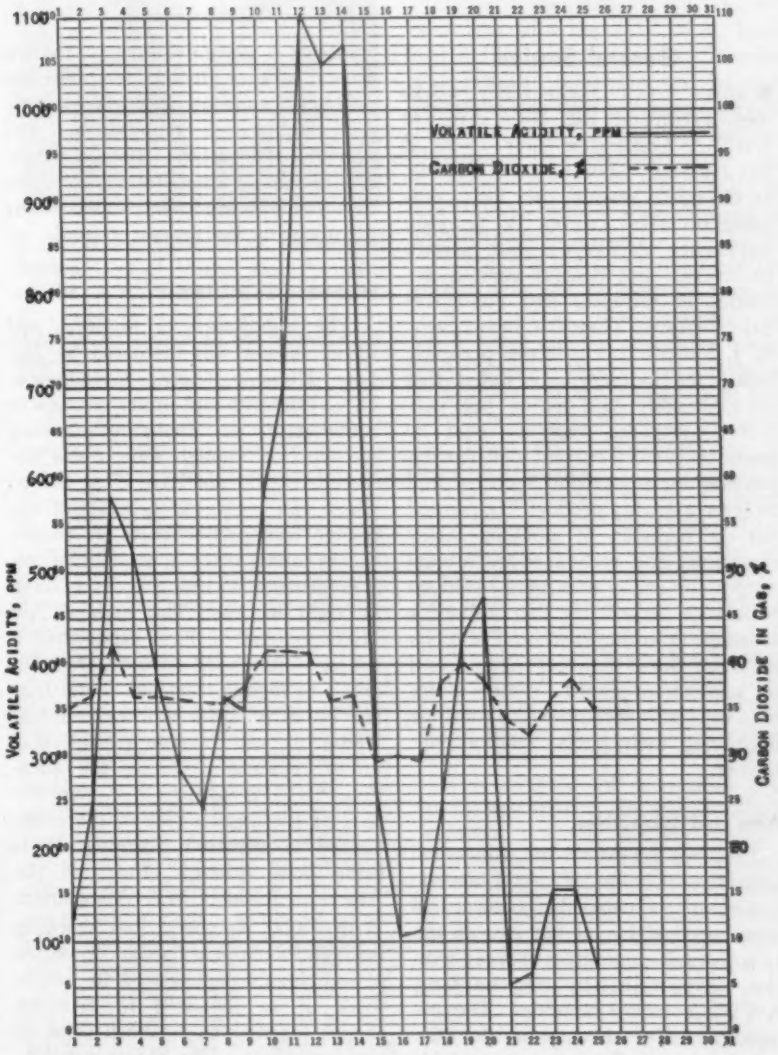


FIG. 4. COMPARISON of carbon dioxide and volatile acids data for functioning digestion process. The increase in carbon dioxide content in the gas often precedes the buildup in volatile acids concentration.

A major accomplishment at the 80th A.W.W.A. Conference was a presentation of . . .

A.W.W.A.'s Aims and Objectives

Part I of 2 Parts

EDITOR'S NOTE: The 80th Annual A.W.W.A. Conference at Bal Harbour, Fla., was opened Monday morning, May 16, by Past President Lauren W. Grayson. The opening address by Mr. Grayson initiated four days of comprehensive technical meetings and discussions. Some of these papers and discussions are abstracted here in Part I of the meeting report.

General Session

■ MORE THAN 3,000 water works men attended the 80th Annual AWWA Conference May 15-20 at Bal Harbour, Miami Beach, Florida. In the initial session, they heard outgoing president Lauren W. Grayson summarize AWWA's past accomplishments and discuss current activities in technical and public relations efforts. They also heard Secy. R. J. Faust hurl challenges presently facing the industry. He stated that approximately $1.2 billion per year will be required over the next 20 years to correct current deficiencies, provide for population increase and to serve a quality product. He pointed out the necessity of studying salary conditions and recommended annual ranges for utility managers based on population served. He also outlined a schedule of educational qualifications for water works managers again based on population served. Water utility men were also encouraged to continue improving their public relations activities.

Aims and Objectives

Progress report of the Aims and Objectives Comm., F. A. Eidsness, Chairman, indicated that reports had been received by all but one of the 12 active sub-committees charged with the responsibility of charting AWWA's future activities. The report concludes that timing for the suggested activities is opportune with association growth approaching 13,000 members. Cooperative effort can establish a technical organization second to none, though members are asking for more services. More money will therefore be required and the Aims & Objectives Comm. recommended that a committee of directors be formed to study ways and means of procuring the necessary funds.

Highways and Utilities

The importance of highway and utility liaison was discussed by Mr. Sam Houston, Atty., Washington, D. C. Highway and utility officials in some states are mutually planning construction, though some areas unfortunately do not have close liaison which can overcome delays and excessive construction costs. A transition is taking place in acquisition, rearrangement, widening and surfacing or right of way. The Federal Aid Highway Act of 1956 established a source of funds for some 41,000 miles of U. S. highway system. Total outlay by early 1970 will exceed $50 billion. It will involve considerable utility relocations raising the question, "who is to pay"? Apparently part of the answer lies in more advanced coordinated planning as is being done through efforts of the American Right of Way Association. With 7,000 members, and working through its national liaison committee of individuals experienced in liaison work, it is dedicated to bringing parties together to establish right of way procedures. The liaison committee is working with the American Association of State Highway Official's liaison committee in twenty-six states and Puerto Rico where utility engineers have been appointed. These individuals deal with the problem of financing utility relocations. More progress is expected as past differences and problems are resolved. (VWL)

Management Division

Research

Water Research in the United States was reviewed by H. A. Faber, USRHS, Washington, D. C. More research is needed today on every problem that has been investigated since the inception of the Lawrence Experiment Station in 1890. Scientists, engineers and management officials concerned with public water supply should be aware of the large gap between what we know and what we need to know to assure provision of safe and adequate water supplies in the future. Five years have passed since an AWWA "Comm. on Research Needs" submitted its report. It recommended that AWWA undertake research support, train research scientists and engineers and provide financial support for research purposes. Some research has been undertaken but topics studied require further work before the ultimate solution is reached. An incomplete 1958 survey indicates that total support of "water supply" research in the U. S. is approximately $1.7 million dollars per year, or about 1 cent per capita per year. Industry and government support of research would serve to supplement and complement each other and a program should be undertaken by the American water supply industry to provide leadership and support needed for long range planning.

Research in Canada was described by A. E. Berry, Ontario Water Resources Commission, Toronto, Ontario. Canadian waterworks research has been supported by many groups, with a present keen interest which is

expected to be intensified considerably. Facilities for this are now available in a modern laboratory research station near Toronto. Research in Canada is supported by the National Research Council at Ottawa, through federal grants and by equipment manufacturers. Canada has no national body devoted primarily to water research, nor is any one group charged with coordination of research studies. This is a major defect and it is recognized that some concerted and coordinated effort is needed to insure maximum utilization of existing facilities.

Research in the United Kingdom was discussed by R. G. Allen, Director, The Water Research Association, Redhill, Surrey, England. Water supply in Great Britain was determined to be under a form of government control during the first decades of the 19th century. World War I demonstrated to the government that Britain's enemies' technical developments represented a serious challenge to her future trade. This caused the government in 1916 to create The Department of Scientific and Industrial Research. This department sought to work *for* industry by creating "research establishments" covering prescribed technical and scientific discipline. Further, it worked *with* industry by offering scientific and financial support for organizations established by a specific industry in studying common scientific and technical problems of its individual firms. These organizations came to be known as Research Associations.

It was more than 30 years before the water industry, stimulated by the increase in awareness that it too was a producer and manufacturer with a need to cope with the ever increasing demands of new and expanding industries around it, recognized a similar challenge—this time from within Britain herself. The Water Research Association was therefore formed in 1955, becoming a grant-aided research association in 1959. Its members are predominently water utilities who sustain a 16-member committee to plan research. Dues are assessed on dollar volume of revenue, equivalent to 0.1 percent of revenue. The Water Research Association's staff currently has 23 members, to be doubled in the near future. Current studies include development of a reliable leak detection device and applications of plastic pipe to water distribution systems. Any results of Water Research Association's investigations are made available to all members of the water industry.

Within the next four years new headquarters to include laboratory and pilot plant facilities, will be available for the association. Studies will include filtration, sludge disposal, more expeditious means of bacteriological analysis, algae control methods, taste and odor control studies, analyses improvements and hydrological problems. Dr. Allen believes that research conducted by the water industry is best accomplished in its own quarters, with its own personnel.

C. F. Wertz, Director of Water and Sewers, City of Miami, Fla.; President of the A.W.W.A.; and Lauren W. Grayson, Past President of the A.W.W.A., delivered the keynote address.

The management division session concluded with an open discussion led by T. E. Larsen, Urbana, Illinois. The topic "What AWWA Should Be Doing in Research" suggested the importance of establishing a U. S. organization to conduct research. Proposal was based on an organization supported by, and operating in association with or separately from, AWWA. The tentative title, Water Research Institute, was proposed for the organization which would draw on AWWA members for its board of trustees and would provide for sustaining members to participate financially. A full time secretary-director would be employed as executive officer for institute administration. An executive council would act on applications and develop plans reviewed and evaluated by a proposed advisory council. Considerable discussion attended the proposal outlined by Mr. Larsen, though the substance of the several remarks was that research is indeed necessary and that AWWA should accomplish it. An important question arose on the means by which such research activity could be financed. It is apparent that a "sales pitch" is required which utility managers can use to their various boards and commissions to obtain participation on the percentage of utility revenue basis. It is hoped that this minor consideration can be worked out and the program be placed into effect at the earliest possible date. (VWL)

Financing Water Utilities

Items of Advancement

The Thursday morning Session of the Advancement-Management Division was aimed at the Public Relations aspect of financing water utilities.

The Water and Sewage Works Manufacturers Association, in cooperation with the A.W.W.A., have had a film prepared titled "Pennies For Health". The film will be presented on free time as a public service feature through 70 television stations throughout the country. After the television showing copies will be available to members for showing as public relations projects.

The film is aimed at acquainting the public with the problem of running a water works, the importance of good water and an adequate supply, and the costs involved in obtaining and producing the supply. The film should be very helpful to Water Utilities faced with raising rates or financing additions.

Fred Merryfield, Connell, Howland, Hayes and Merryfield, Consulting Engineers, discussed the advancement program accomplishments. He feels that professional advancement is necessary to improve comunity public relations. While engineering is a science, Public Relations is an art. The public is apathetic to the water utilities because we let them be.

The management education program, essential to the Water Works industry, is slowly making headway. Management education is essential to most water facilities. Management may be learned and we must advance in this phase of activity. The water works field is not supporting the industry—while there are 18,000 water utilities in the United States, the A.W.W.A. has only 12,000 members.

Paul Haney reported for Howard J. Sowden on the work responsible for a favorable referendum for a water

improvement program at Fergus Falls, Minnesota. Due to good public relations, letting the public know all the facts, the referendum was passed by a 90 per cent favorable vote.

In order to maintain the good public relations necessary for favorable reactions to rate increases and bond issues, consumer satisfaction is of prime importance. Management personnel should belong to local service clubs and have talks presented to these groups periodically.

The hiring of Consulting Engineers to prepare unbiased reports for new facilities or programs is important. This takes the load off the local managers.

Robert S. Millar, Secretary-Manager, Board of Water Commissioners, Denver, Colorado, discussed the keys to success in obtaining favorable reactions to bond issues in Denver.

Good service is extremely important to have satisfied customers. Public education, especially through the schools by trips through the plants, a favorable press due to honest and straightforward answers are necessary for success. When it is possible, a good technique is to get the public to insist on improvements.

As was true with Mr. Sowden, Millar feels that Consulting Engineers are very important for guidance in improvement projects.

Annual reports of operation should be explained to the public. School children will be the voters in a few years; a simple brochure for them when they visit the plant will be remembered.

The success for the last two bond issues in Denver, with rate increases in each case, was due to cooperation of the press with well-timed releases, television publicity, radio panel discussions and 30 second prestige spots on radio by well-known community leaders.

The vote was 3 to 1 in favor of the improvement program in spite of a 35 per cent rate increase.

Following the same line of thought, Thomas V. O'Leary, Vice President, Philadelphia Suburban Water Company, discussed "Community Relations Is a Day-to-Day Job". He does not feel that it is necessary to hire public relations experts. Good business common sense is required.

Philadelphia Suburban Water Company is privately owned, creating certain problems not faced by publicly owned facilities.

Groups of students are encouraged to visit the company's facilities. Well-trained guides are available to explain the facilities to the students. A 6" ruler and a first aid card are given as souvenirs to each student. Each group plants a tree on the grounds and can observe its growth on future visits.

Employees of the Company are active in community affairs, bringing recognition to the Company. All employees complete a training program during their first weeks of employment so that they can talk intelligently about the Company's facilities and also so that they can advance within the organization. (RWS)

Dr. F. A. Eidsness and Dr. A. P. Black, both of Gainesville, Fla., National Director and Past President of the A.W.W.A., respectively, received the Association's annual Purification Division Award.

Resources Division

General Session

At the General Session of the A.W.W.A. meeting in Miami on Wednesday, May 18, 1960, attention was directed to protection of our water resources. At the beginning of the Session, a block and gavel, made from wood pipe removed from the Philadelphia Water System, was presented by Gerald E. Arnold to retiring President, Lauren W. Grayson.

Theodore M. Schad, Staff Director, Select Committee on National Water Resources, U. S. Senate, reported on findings of the Senate Committee to date. He reported that with all our scientific know-how and ingenuity we have not yet figured out how to get more fresh water than nature provides, so we must plan water development; we cannot count on a scientific miracle to help us out. Progress reports from various agencies engaged in research and development give no concrete evidence that a breakthrough in technique for meeting needs for fresh water through desalinization of ocean water or increasing precipitation through cloud seeding is in prospect. We cannot count on these supplies as practical to meet future water demands.

The United States is fast approaching the time when we will need and use all the water we can possibly get from every conceivable source. It is obvious that conservation of stream flows and greater use of ground water is imperative, but we must also concern ourselves with the salvage of previously used water of every sort, as well as the vigorous elimination of waste in water storage, transportation and use.

Data correlated by the Senate Committee indicates that by 1980 certain areas of the country, principally in the southwest, will have demands in excess of the available supply. The other areas of the country can meet requirements by building dams and reservoirs for virtually complete control of river flows. We must create an atmosphere of concern and not passively waste our natural resource —water. The Committee's task is to forecast the national growth and social and economic changes over the next 20 years, as they may affect water supply and use.

Projections of the Committee cover the whole broad range of water uses and water-related activity including municipal, industrial, waste disposal, navigation, agricultural, flood control, recreational and fish and wild life needs.

Quality of water must be preserved as well as quantity. We are much better prepared technologically for providing greater quantities of water than we are for improving the quality of the water.

Sewage treatment processes rely greatly on dilution of the treated sewage with fresh water. The Public Health Service computations indicate such a large quantity of storage will be required to provide the required dilution of treated sewage that dilution becomes impractical and we must find new techniques for treating sewage from a purely economic approach. By the year 2000, it is predicted that the sewage and waste load will be 4 to 5 times the currently available amount of reservoir storage to meet only dilution requirements currently considered satisfactory.

Increased sewage treatment efficiency is not the answer, based on

present methods commonly used, since we reach a point in treatment efficiency when the effluent provides nutrients for plant growth, such as nitrogen and phosphorous, placing even a greater load on surface waters.

Studies of the Committee indicate that by 1980 national water needs will be approximately 600 billion gallons daily. This is approximately one-half the total average run-off of all streams in the United States and may be the practical limitation of storage and development. It is apparent that reuse of water is a must, to meet demands. Further, our present methods of treating sewage and industrial wastes must be overhauled, with new treatment processes, based on new concepts and principles developed. Elimination of biologically inert material, discharged from waste treatment plants presently, must be reduced to reduce dilution requirements. Even with improved techniques in waste treatment, and increased reuse of water we shall still ultimately need full conservation and regulation of waters in the United States.

Storage requirements have been predicted to be 225 million acre-feet by 1980, and 420 million acre-feet by 2000, unless improvements in treating sewage are developed.

Mark D. Hollis, Assistant Surgeon General and Chief Engineer, U. S. Public Health Service, continued the discussion of Water Resources, with particular emphasis on protection. He stated that while more water was a critical national problem, distribution of the water where required, and pollution of our surface waters, was foremost for consideration. Much more can be done towards reuse of water to preserve this necessary resource.

Distribution of water poses legal and political problems, especially where diversion between watersheds may be necessary. Desalting, which would also impose a distribution problem, is a long way off as a practical solution.

We must conserve water by tightening up on pollution, but additional scientific data is required to improve pollution control.

Statistics indicate that 100 million people use surface waters as a source of supply whle 105 million people discharge their sewage, treated or untreated, to surface waters, as of 1960.

New contaminants such as complex organic compounds are being discharged to surface waters. The compounds are now removed by present sewage treatment processes and cannot be effectively removed with present methods of water treatment. While the concentrations of these "exotic" compounds are low, they will increase and spread. Combinations of these organics further complicate the picture for the water plant operator. Since we are not fully aware of what the compounds are, nor their effect, the problem is of great concern to Public Health Authorities.

Mr. Citizen is too busy to pay attention to these problems, therefore professional and scientific groups must provide the specific research required to combat this problem.

Florida is active in conserving its water resources. John W. Wakefield, Director, Department of Water Resources for Florida, informally discussed Florida's approach to conservation of water, by storage of rainfall for drought seasons. Various areas in the State have been set aside for catchment ponds and lakes, in order that controlled discharge to the principal surface streams can be maintained. (RWS)

Following the discussion of Water Resources at the General Session, Lauren W. Grayson reviewed the proposed revisions to the A.W.W.A. Constitution and Bylaws, which will be acted on by the members shortly. Members were urged to study the revisions as set forth in the Journal, March 1960. It was felt by Grayson that the revisions would make a more workable Constitution under present day problems. (RWS)

Salt Water Encroachment and Water Recharge

Matthew I. Rorabaugh, District Engineer, U.S. Geological Survey, Ground Water Branch, Tallahassee, Florida, has been concerned with salt water intrusion into the fresh water aquifer supplying the Florida area.

Since waste water discharge will continue, recharge of the waste water to the ground water aquifer is required, to prevent salt water intrusion. We do not have a great deal of technical knowledge regarding the science and technique of recharging, and considerable research is required to provide a workable program.

At the point where fresh water and sea water meet, the fresh water moves upward, due to the difference in specific gravity. This upward movement forms a wedge which tends to repress the salt water intrusion. When waste water is recharged to the fresh water aquifer in the vicinity of the wedge, it must be added slowly, in in order not to disrupt the balance existing, and to build up the fresh water pressure.

Such wastes as air conditioning water, laundry wastes etc. have been successfully recharged into Florida's aquifers.

The water table in the North Miami well fields has been dropping, due to increased use and reduced natural recharge caused by draining of the Everglades. Francis A. Kohout, a geologist in the U.S. Geological Survey, Ground Water Branch, Miami, Florida, reported on results of natural recharge investigations.

Fresh water, from rainfall and from the Everglade Area, was drained off rapidly by construction of drainage ditches built for this purpose. The ditches served the purpose they were originally designed for but, as flow decreased, salt water backed up the ditches thus fostering recharge with salt water and increasing the opportunity for salt water encroachment.

As a solution to this problem, salt water encroachment dams were constructed in the drainage ditches, to prevent this back-up of salt water. Prior to construction of the dams, the chloride content in the ditches reached 1600 ppm, but was reduced, after dam construction to 400 ppm.

Salt water underlies the North Miami well field. Natural recharge must exist to reduce the danger of encroachment.

The Federal Government, in conjunction with the University of Arkansas, has carried on a research project on ground water recharge in the Stuttgart, Arkansas Area. Richard T. Sniegocki, Acting District Geologist, Ground Water Branch, U.S. Geological Survey, Little Rock Arkansas, discussed the results of this research project in a panel discussion. The ground water levels have dropped 60 feet since 1915 in this area, due to excessive pumping.

In order to recharge the ground water with surface water, it was found necessary, early in the study, to treat the recharge water completely in order to recharge only clean water. The treatment consists of 3 grains

per gallon of alum, followed by rapid sand filtration. While the treated water was pumped down into the test well, the water level in adjacent wells held up, but as soon as recharge pumping stopped the water level dropped off quickly.

Rice is grown in the Stuttgart area with the result that large quantities of ground water are used for irrigation, providing an excellent point for the research project.

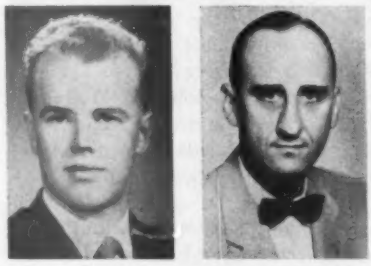
During the study 20 million gallons were injected into the test well over a 40 day period. Low turbidity water was required in order to prevent fouling up the screen. One result of the investigation was that temperature played an important part in recharge. During the winter, when water temperatures decreased, 10 feet additional head were required to inject the same amount of water as could be injected in the summer. With the same discharge head, 602 gpm of 64° water could be injected or 310 gpm of 43° water.

At the same panel discussion, W. L. Broadhurst, Chief Hydrologist, High Plains Underground Water Conservation District, Lubbock, Texas, discussed recent work in recharging wells in the West Texas plain area. Since there is only an average of 20" of precipitation in this area, irrigation is necessary for crops. All irrigation water is obtained from ground water. The natural recharge is only available from rainfall. The soil in the area is impermeable thus it is next to impossible for precipitation to get down into the ground water aquifer. The natural retention in ponds and plains lakes varies from 20 inches to one-fourth of an inch per year.

Investigations indicate there is an estimated 400 million acre feet of stored water in the underlying aquifer. From 1910 to 1959, an estimated 50 million acre-feet have been withdrawn, with the bulk being pumped between 1950 and 1959. The current rate of withdrawal is estimated to be 5 million acre feet per year.

The existing depressions or plains lakes have impermeable bottoms; evaporation of water takes place rapidly in this area, with little or no seepage or recharge.

The problem faced by the Conservation District was to get the surface water resulting from precipitation back into the underground aquifer. Recharge wells were developed close to the lakes with conventional drilling and screening equipment installed. When the lake water was drained by gravity, from a beginning rate of 1050 gpm, after 8 days the rate reduced to 200 gpm due to clogging of the well screens with silt. The wells were redeveloped to remove the silt, with an influent rate of 1400 gpm, reducing to 800 gpm in only 23 hours. If the wells were recharged for 23 hours, then pumped to waste for silt removal for one hour, the input could be maintained for as long as 30 days. During the one hour pumping, 7.7% of the clay deposit was removed.



Walter R. Drynan and Ernest F. Gloyna, both of the Civil Engineering Department, University of Texas, Austin, Texas, received the Resources Division Award of the A.W.W.A.

The fine grain sand and clay moves into the aquifer, permanently reducing the recharge well capacity by an estimated 15%.

The most effective method of removing the fine turbidity, was at the source, in the lakes proper, so that clean water could be used for recharge. In order to artificially induce clarification in the ponds and lakes, Separan was dusted, by crop dusting equipment, over the surface of the water. Where the water was hard, excellent results were achieved; with soft water, agricultural gypsum must be added with the Separan. It was estimated that treatment for solids removal cost approximately $2 per acre foot of water treated. Most of the settleable solids were settled out in the lakes in this manner.

There are 130 recharge wells in operation in the High Plains Conservation District now.

Owen Jensen, Layne Texas Company, reported for Glenn R. Hotchkiss concerning recharging operations at the King Ranch in Texas. Here gravel packed wells were developed into the aquifer for recharging purposes. Diatomaceous earth filters are used for clarification of the ground water, with a finished water of 5 ppm turbidity pumped into the gravel packed wells. This procedure has been successful in recharging the underground aquifer in the area.

W. Fred Welsch, Sr., Hydraulic Engineer, Nassau County, Department of Public Works, reported on the Nassau County ground water resources investigation begun in 1932. Sixteen observation wells have been drilled along the coast to check and observe salt water intrusion.

Recharge basins are used throughout the County to allow rainfall to percolate into the underground aquifer. There are 438 recharge basins in the County, each approximately one acre in area. The recharge basins are designed as two compartment units; the first unit for settling, the second for percolation. The basins are designed for a 5 inch rainfall in 48 hours which will occur in the area once in 5 years. The seepage or percolation rate is approximately 1.0 M.G. per acre per day.

A demand of 40 M.G.D. of ground water has been estimated for Nassau County, and the aim is to recharge the same amount of water. (RWS)

Water Shortages

Joint Sealing in Concrete-Paved Reservoirs was described by H. W. Tyler, City Engineering Department, Seattle, Washington. Joint sealing in concrete-paved reservoirs has evolved slowly in the last 20 years. The common copper seal has been replaced by modern plastics and sealing compounds producing a tighter, more economical joint. The two essential sealing elements in a good joint are a waterstop cast into the slab and a sealer at the surface of the joint. The waterstop prevents the semi-plastic sealer from being forced through the contracted joint under water pressure and the sealer assists in sealing against leakage and keeps sand or silt from compacting in the joint. Proper construction of these two elements assures a watertight joint. A number of good waterstops are on the market today consisting of an extruded form of polyvinylchloride or molded synthetic rubber in continuous strips. One successful sealer is a cold-applied, two-part polysulfide compound, the two parts of which are mixed at the site and used immediately.

Partially Oriented on . . .

Geologic for Water Engineers

Theorems 1 to 21

Fundamentals.

1. A geologist's hammer is not equal to or greater than The Great Forces in Nature.
2. If two geologists shall come from two different universities, then their geological theories shall be opposed to each other as two sides of a fault.
3. If, at any first glance, a given geological proposition appears to be obvious, then however many additional explanations are given that proposition still remains obvious.
4. It may be assumed that a fossil does not know how it got there. If it did, the fossil might be more surprised at the geologist than the geologist at the fossil.

Field Geology.

5. Any part of a given geological series may be mistaken for another part of the same series or for another part of another series.
6. If, at any two points A and C distant more than 15 feet apart, trial holes shall have been sunk and the nature of the ground at these two points shall thereby be deemed to have been determined, and each shall be found similar to each, then the nature of the ground at B, which lies midway on the straight line joining AC, shall not yet have been determined.
7. A fault may be alleged to be a line drawn on a map, or a plane in the field; but it may be supposed that it is more likely to be the trouble you are in when you are in one, and look back.
8. A conjectured fault is *only* a line drawn on a map.
9. The present value of a previously abandoned quarry may be more accurately evaluated by locating the whereabouts of the person who abandoned it and asking him why.
10. If, from any station point P, an observer shall observe a rise (or fall) of the surface of the ground and shall thereby conclude that there is an equal rise (or fall) in the underlying strata in the same direction, then that observer should himself be placed under observation.
11. A trial pit is never started large enough.

Things and Substances.

12. If it be assumed that soil exists, then it is not a term defined in the science of geology, but is a term used by, or invented by, soil mechanics.
13. Rock is not a definition but a class of objects comprehending several species of differing character. Colloquially it is any material of special inconvenience which cannot be dealt with by a Contractor under the terms of his contract.
14. Soft material may be defined as that material which is not rock. Colloquially it may be taken as that material which, not being rock, is of special inconvenience to a Contractor and therefore connot be dealt with under the terms of his contract.
15. If, by naming, it be assumed that any of the following materials —namely boulder clay, chalk, friable rock, loam, shale, sandy-gravel, subsoil—are defined, then it follows that despite the naming, the true nature of the material has yet to be determined.

Water Geology.

16. A Water Diviner is to Geology as the Old Testament is to Modern Physics.
17. Of two propositions of doubtful validity; namely—(A) all dams leak, or (B) this dam does not leak—experience indicates that the validity of the former is less open to disproof than the validity of the latter.
18. If, in regard to any dam, the number of exploratory foundation boreholes sunk shall be N, and if in addition N-1 boring logs shall have been returned and examined without account given of the reasons for the missing borehole log, then it shall be found that the maximum difficulty encountered in building that dam shall occur at the site of the missing borehole log.
19. If, in regard to any water retaining structure, it shall be alleged that that structure is watertight then, as a first proposition it may be assumed that the amount of water entering that structure is equal to or greater than the amount leaking out, until proof is given otherwise.
20. If, at any point O there shall have been sunk a borehole, and it shall have been determined with great care that the abstraction of X m.g.d. from O cannot conceivably, even in the driest summer, affect the yield of any other borehole distant more than R from O, then it follows that, whether pumping is taking place at O or not, there shall always be a person owning a well at P, distant 10R from O, who shall swear that he can prove that abstraction from O adversely affects the yield of P.

Conclusion.

21. Other things being equal, an obtuse-angled geologist is preferable to an acute-angled contractor; but a right-handed engineer can be the equal of either.

A saving of $70,000 is expected through the use of . . .

Automatically Controlled Variable Speed Pumping

by V. A. VASEEN, Pres.
Ripple & Howe, Inc.
Consulting Engineers
Denver, Colo.

EDITOR'S NOTE: Shortly after completing its treatment plant the North Washington Street Water and Sanitation District was faced with the fact that a revision of the State Health Department standards required major improvements in their plant if the new effluent standards were to be met. Growth in the population of the District which is located outside Denver also indicated that expansion of the plant's capacity would also be advisable when construction was done to meet the new state requirements. Original estimates of the cost of both the expansion and the changes necessary to raise the effluent quality were $341,000. By replacing the original plans for a set of fixed output pumps of various outputs with variable speed pumps and utilizing automatic control sensing the level of the pump sumps it was possible to reduce the estimate to $270,000 and not increase estimated operating costs.

■ IN MARCH 1954 the North Washington Street Water and Sanitation District submitted plans and specifications to the Colorado State Board of Health for a complete sewage treatment plant with a design flow of 1 mgd, based on a 16-hour day. The design was for a population of 12,000 persons, having a per capita water use of 70 gpcd.

Existing Plant

This design consisted of screening and grinding facilities for a plant of 5 mgd capacity. This equipment was laid out with the thought in mind that at some future capacity, it might be desirable to move this screening and grinding equipment to another structure, to make room at its location in the control building for standby power equipment. Primary clarification was provided in one 65 ft diameter x 7 ft 6 in. side water depth clarifier, sized to meet design requirement with a 1 to 1 recirculation of filtered effluent, a total flow of 2000 gpm. At the 1 to 1 recirculation rate the clarifier has a detention period of one hour and thirty four minutes; a settling rate of 577 gallons per square foot of surface per day and an overflow rate of 9.8 gallons per linear ft of weir. High rate bio-filtration was provided in a 100 ft diameter by 4 ft 6 in. stone depth filter designed for an influent load of 2000 lbs of BOD per acre ft per day, or a total load on the filter of 2450 lbs of BOD per day. Temporary secondary settling was arranged for by constructing a final effluent oxidation pond having slightly over an acre of area, with a maximum design loading approximately 477 lbs of BOD per day. If the pond needed additional dissolved oxygen it could be introduced by adding to the pond irrigation water containing dissolved oxygen.

New State Requirements

On January 14, 1957, the Colorado State Board of Health raised the standards which will be required by sewage treatment plant effluents in the State of Colorado and gave the communities and sanitation districts within the state until January 1, 1958 for compliance. The new requirements of the Colorado State Board of Health are:

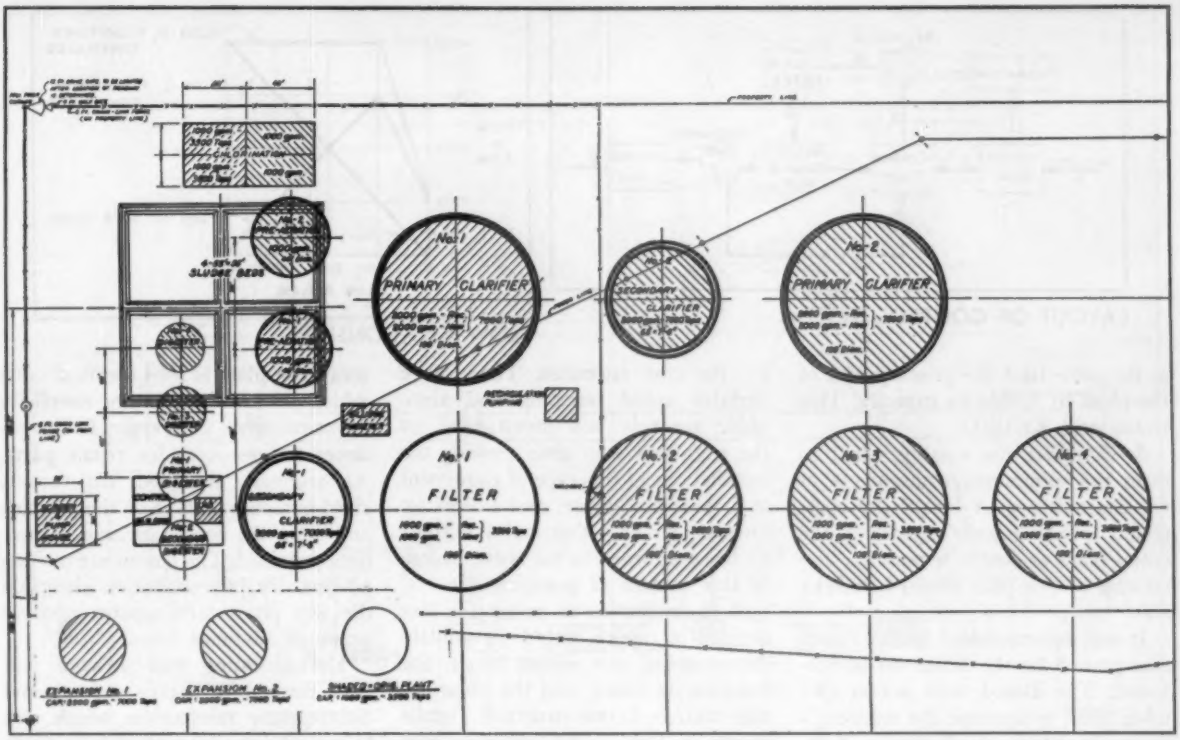
"Sewage treatment plant effluent shall not exceed 50 mg/l of BOD when discharging into a stream not used as a water supply below the point of discharge, or 30 mg/l of BOD if used as a point of water supply below the point of discharge, and that suspended solids shall not exceed 75 mg/l. The pH range shall be within the values of 5.5-10.6.

The volume of sediment in the ef-

Table I

Construction Increments

			Totals
1st	New Primary Clarifier (100 ft diam.)	$ 67,500	
	Portion of Recirculation Facilities	33,500	
	Portion of Yard Piping	7,500	
	Secondary Settling	500	
	Sub-Total	109,000	$109,000
2nd	Chlorination	40,500	
	Portion of Yard Piping	5,000	
	Sub-Total	45,500	$154,500
3rd	Balance of Recirculation Facilities	12,300	
	Balance of Yard Piping	2,500	
	Sludge Thickening	16,500	
	Sub-Total	31,300	$185,800
4th	New Screen and Control House	100,000	
	New High Rate Filter	55,500	
	Sub-Total	155,500	$341,300



PROPOSED Expansion Plant Layout

fluent shall not exceed 0.5 ml when the test for settleable solids, by volume, is made in accordance with Standard Methods for the Examination of Water & Sewage, Ninth Edition. For the purpose of these regulations, blood and meat scraps shall be considered settleable and floatable substances."

The original plant was approved by the Colorado State Board of Health, as a "complete" plant, but this *action* of the Board of Health made it an "intermediate" plant. The additional requirements of sewage treatment plant require it to be improved in design as follows:

a) Secondary settling by mechanical means.

b) The final effluent to be chlorinated with a content period of not less than 15 minutes based on maximum hourly flows and also be able to discharge an effluent having a chlorine residual of from 3 to 5 mg/l.

Due to the arrangement of the original plant structures the state felt it would be advisable to provide new recirculation pumps and controls, in order to permit return of the effluent from the trickling filter to varying elements of the plant, as well as provide for chlorination.

The original plant was constructed in 1954 at a cost of approximately $200,000 including equipment and engineering. In order to improve the plant to minimum State Health Department requirements would require a new secondary clarifier 45 ft in diameter for $24,000; chlorination, super-structures and automatic chlorinator $30,500, recirculation pumps, wet pit and super-structure building, piping, valves, mechanical, and automatic controls $38,500; and miscellaneous piping in the yard $10,000, for a grand total of $103,000. Following these expenditures, the plant would have an effluent which would comply with the standards, but the plant itself would be at variance with their requirements in several respects.

Table 2

Breakdown of Costs

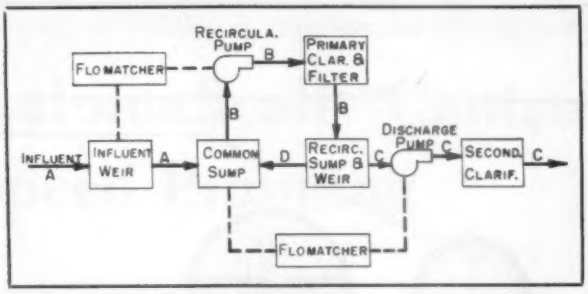
	Equipment	Contract	Total
New grit, screen house and pump station	$24,600	$ 75,400	$100,000
New Primary Clarifier	16,000	51,500	67,500
Convert existing Primary Clarifier to Secondary Clarifier	0	500	500
New High Rate Filter	5,000	50,500	55,500
Chlorination Facilities	6,000	34,500	40,500
Recirculation Facilities	11,800	34,000	45,800
Yard Piping Revisions	0	15,000	15,000
Sludge Thickening	7,000	9,500	16,500
TOTAL	$70,400	$270,900	$341,300

Expansion Plans

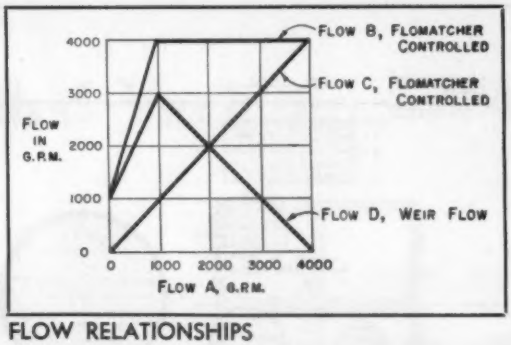
Following the action by the Board of Health, the Board of Directors of the District, authorized the authors firm to prepare a report on possible solutions to the problem. The report was presented to the Board in September, 1957 and recommended the following three alternate plans of action:

1. Complete the existing plant to meet the minimum requirements for the present design population. This would cost approximately $100,000.

2. Complete the plant to meet Health Department requirements and



LAYOUT OF CONTROL SYSTEM.



FLOW RELATIONSHIPS

at the same time the primary part of the plant to double its capacity. This would cost $263,500.

3. Complete the existing plant to meet the minimum requirements of the State Board of Health by completely revising and expanding the entire plant to double it capacity. Total cost of this plan would be $541,-300.

It was recommended to the Board that plan 3 be the action to be followed. The Board took action October 1957 to approve the engineer's recommendation. As a means of financing the Board adopted a regulation requiring an aditional $100.00 per tap connection fee over and above the $150.00 being collected to pay for sewer lines. The extra $100.00 to be placed on deposit until sufficient funds were collected or additional funds could be added to those collected to expand the plant.

The Colorado State Board of Health in reviewing the Report placed restrictions on the Board as follows: 1. that the Board of Directors would in writing, notify the Board of Health, that they were aware of the need of expansion of the Sewage Treatment Plant and 2. that final plans and specifications would be engineered so that by the time financing was available, time would not be lost in having final plans and specifications made.

The plans provided for the expansion were revised in such a way that the Board could, if necessary, construct various portions of the work and ultimately achieve an over-all expansion of the plant. The arrangement of the construction of new facilities and revision of old facilities were as shown in Table 1.

New Design

Programmed pumping with five pumps with capacities from 250 gpm to a total of 5,000 gpm was the basis for the cost estimates. The use of variable speed pumping and automatic controls was investigated by the engineers who after viewing the installations of this type of equipment at Corvallis, Eugene, and Roseburg, Oregon, deciding that major savings could be afforded to the client by use of this system of pumping.

A re-orientation of structures was decided on which would consolidate the proposed new screen house, the pumping facilities, and the chlorination controls in one structure. Details shown in Fig. 1. All incoming raw sewage from both the main 24-in. outfall sewer from the south and the 24-in. outfall sewer from the north were collected in one 33 in. main at the plant site. The raw sewage discharges into the west, wet pit ahead of the pumping controls. From the wet pit the sewage overflows over a weir to the sump for the raw sewage lift pumps.

The height of flow over this weir controls the speed of two 75 hp two 2000 gallon per minute maximum, variable speed pumps, driven by wound rotor motors 700 rpm to 1000 rpm through variable controls. The incoming sump has a sluice gate at the bottom so from time to time any solids which might occur in the sump can be flushed. A feaure of the design is that any "flood" conditions, that is excessive flows over and above maximum capacity of the raw sewage pumps, cause the water level to rise and overflow into the re-circulation wet pit on the east side of the pump sump. At this level the re-circulation pumps to the secondary settling tank thus guarantee at all times at least primary treatment. This is made possible by the elevation control in the recirculation wet pit which automatically close the re-circulation control valves and transfer the flow to the secondary settling tank.

The pumping for the entire sewage treatment plant is by 4 identical units which affords the operator simplicity of maintenance and repair. It also reduces the necessity for repair parts. As originally designed, ten various sized pumping units, 5 on the primary and 5 on the secondary would have been provided. The pumps are mounted in a dry pit installation alongside the wet pits which assures positive prime at all times.

The incoming raw sewage will pass through a rotary screen, and disintegrator mechanism which will be moved from its present location in the digestor control building to its new location on the west side of the new structure adjacent to the wet pits. A feature of the design of this building is the isolation of the screening and grinding facilities from the balance of the building. A plate glass window affords the operator a full view of the entire operation and yet restricting odors to that part of the building which has its own ventilation system separate from that of the remaining portion of the building.

The ground floor level of the building houses four one ton chlorine tanks, along with two automatic chlorinators, which can be used for either pre-chlorination or post chlorination. If necessary they can be used in parallel for either "pre" or "post" chlorination. The grit will be removed from the sludge by use of a centrifugal separator, prior to sludge being thickened. The grit will be washed prior to the discharge by means of a screw type classifier which discharges through the wall of the building to storage buckets pending final disposal.

The top floor of the building, or the second story above grade, will be completely glass enclosed. Here will be housed the control cabinet, files and other equipment required by the operator. In this control room a view

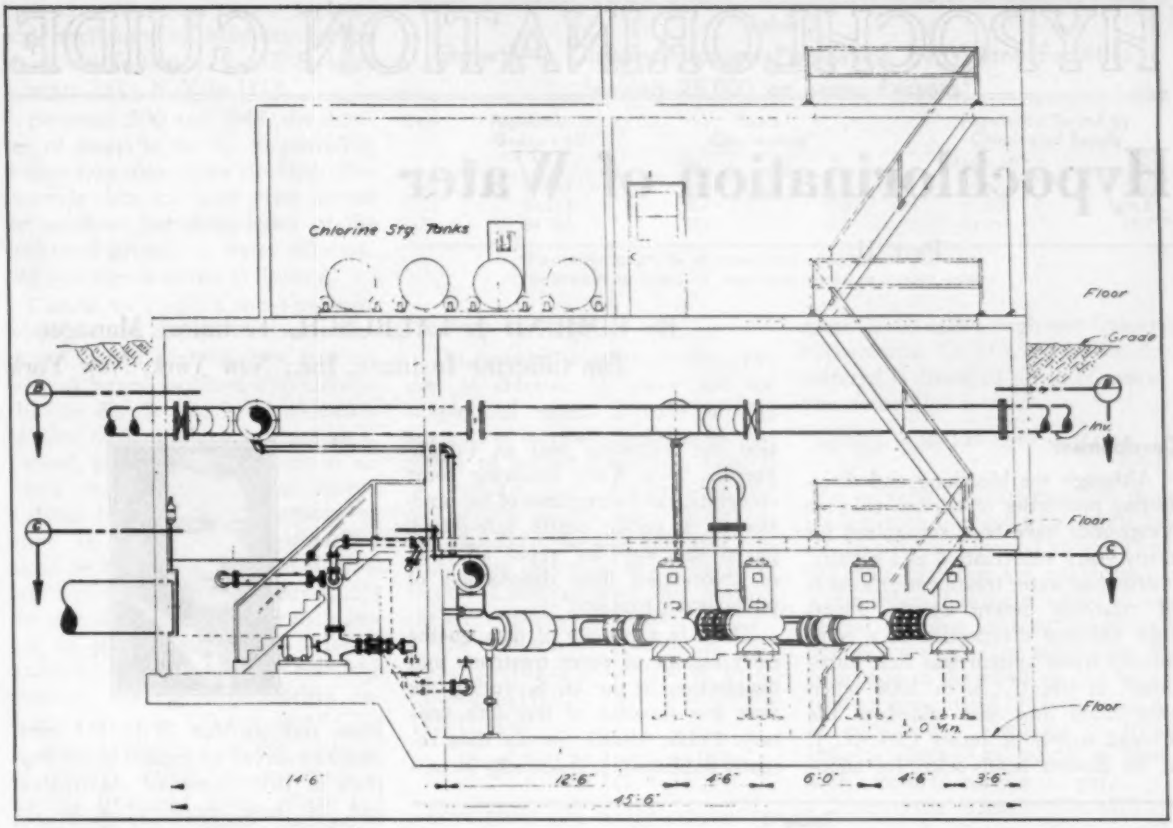


Fig. 1 DETAILS of One Story Structure Consolidating Screen House, Pumping Facilities and Chlorination Controls

of the entire plant will be provided for the operator together with a set of controls which will permit him to stop, start and adjust any operations.

The District has not as yet had time to accumulate sufficient funds to proceed with the construction of the plant, but from an analysis of the cost of the structures involved, it is believed that through the use of this composite structure along with controls and variable speed pumping, the original estimated cost of $341,300 can be reduced to $270,000. Table 3 shows a breakdown of the new cost estimate.

Power costs have been analyzed with regard to the use of the variable speed units and it is expected that the total overall efficiency of pumping will be for all practical purposes the same as it would have been when using five programmed, varied capacity pumps, for the raw sewage, with duplicate units for re-circulation. This can be evidenced on examination of the attached pumping curve.

The flexibility, designed and engineered into this plant, will give the sewage plant operator a maximum control of the handling of both the raw influent sewage to the plant as well as the return of primary or secondary effluent to re-circulation. The raw influent to the plant contains waste from five meat packing plants, and at times runs as high as 1500 mg/l of BOD. Many times it averages for several hours in excess of 500 mg/l of BOD. As a result it takes extreme flexibility in order that the plant operator can meet at all times the State Health Department requirements of an effluent which will not contain more than 50 mg/l of BOD.

Table 3

New Breakdown of Costs

Control House and Recirculation Structure	$ 30,000
Controls, including Air Compressor for operating automatic valves	4,000
Pumps and appurtenances, installed	15,000
Piping and Valves, except yard piping	25,000
Automatic Chlorination	8,000
Electrical work, including the relocation of existing control panels	10,000
Boiler and controls	3,000
Flomatcher units and controls	16,000
New Primary Clarifier Tank and equipment	50,000
Sludge Thickening equipment and piping	20,000
Chlorination Retention Tank and Controls	20,000
New Bio-Filters	50,000
Portion of the control house to be used as screen and grinding building and appurtenances, as well as moving existing equipment to its new location	10,000
Degriting Unit and installation	4,000
Complete forced air ventilation of the control and screen house	5,000
Total Cost of Additional Construction	$270,000

Equipment

Clarifiers, Distributors, Screws, Grit Separator, Disintegrator by Dorr-Oliver Flow Control and Pump Controls—Flowmatcher Controls

HYPOCHLORINATION GUIDE

Hypochlorination of Water

Part II

By EDMUND J. LAUBUSCH, Technical Manager
The Chlorine Institute, Inc., New York, New York

Development

Although the bleaching and disinfecting properties of various chlorine compounds have been recognized for many years, chlorination as a regular, continuous water treatment process is of relatively recent origin. Plant-scale chlorine disinfection of a community water system was first introduced in the U. S. in 1908 when chlorinated lime was added to the 40-mgd supply of Jersey City, N. J. at its Boston headworks. Its adoption the following year at Poughkeepsie, New York following court recognition and acceptance of the practice as a public health safe-guard, paved the way for rapid adoption of chlorinated lime disinfection of public water supplies.

There is a paucity of data on the early history of water treatment and disinfection in the U. S. during the first few decades of the 20th century. Public Health Service data recently published, 1, reportedly incomplete, indicate that 18 of 557 communities served by treated water supplies in 1910 employed chlorination and, of these, employed it as the only treatment. Only five years later, in 1915, 340 of the 830 communities so served employed chlorination, and the number of persons receiving the benefit of chlorinated water was about 15.6 millions (in contrast to about 1.2 millions in 1910). Data are not available on the number of plants at which liquid chlorine was employed at that time, but it is probable that the majority employed chlorinated

Table 1
Summary of Growth of U. S. Water Plants Employing Disinfection[1,2]

Year	Plants Chlorinating	Increase	Chlorine Forms Employed			
	No.	%	Hypochlorite	Gas	Both	Misc. or Unknown
1910	18	—	—	—	—	—
1915	340	1790	—	—	—	—
1930	2917	755	—	—	—	—
1940	4650	60	728	2563	?	1359
1948	6137	32	1557	3613	37	930

This is a series of articles to be presented in four parts dealing with hypochlorite-chlorine materials and their use in environmental sanitation control. Among the subjects that will be reviewed include: the nature, manufacture, storage and handling of hypochlorites; principles fundamental to hypochlorination processes, especially as they relate to municipal water supply, swimming pool and wastes treatment practices; and a discussion of hypochlorite feeding and dosage control equipment that facilitates their safe and effective application.

Writings on the subject are numerous and no single treatise is or can be complete unto itself. These articles are not purported to contain all or even a majority of principles, facts or techniques relating to the subject. The information to be presented is believed to be reliable and reflects the experience of many producers and consumers of hypochlorites, and of purveyors of equipment suitable for their handling. With regard to handling and safety suggestions, readers are cautioned that certain circumstances may warrant modified or additional procedure; moveover, cognizance must be taken of any federal, state, municipal, insurance or other requirements that might apply.

lime since the first recorded plant-scale application of liquid chlorine for water disinfection in the U. S. is at Niagara Falls, N. Y. in 1912.

Between 1930 and 1948, the number of plants in the U. S. providing disinfection more than doubled. Nationwide data for later years is not yet available but some index of the continued growth of water chlorination practices is shown in Table 2.

Clearly, as Tables 3 and 4 indicate, while the use of liquid chlorine surpasses that of hypochlorites, particularly at larger facilities, hypochlorite chlorine disinfection is by no means obsolete or diminishing in importance. Indeed, at least 4.3 per cent of all water works facilities that served communities of 25,000 persons or more in 1956 used hypochlorites, alone or in combination with elemental, liquid chlorine.[4] Moreover, for the period 1940-1948, while the number of plants using liquid chlorine increased by about 40 per cent, the number utilizing hypochlorites increased by over 110 per cent.[2] This is undoubtedly due to the adoption of chlorine disinfection processes at smaller treatment plants where hypochlorites are especially appropriate and where the need for extension of disinfection benefits is most evident.

Considerable refinement and progress has occurred during the past half century in the quality of commercial hypochlorites and feeding devices. In its infancy, disinfection was accomplished by employing either chlorinated lime (chlorine of lime, bleaching powder etc.) or sodium hypochlorite. Also, solution-feed equipment then available yielded spurious and erratic results. Impetus to effective water chlorination came with the commercial availability of liquid chlorine (1909) and proprietary chlorinators (1912-13); the proposal of a practical colorometric method for chlorine residual determinations (1909) and its development and subsequent adoption; and, finally, the appearance (in 1928) of high-test (70% "Available Chlorine") hypochlorites. The advent of this material (as did liquid chlorine) also brought about diminished popularity of sodium hypochlorite for potable water disinfection. Statistics on the relative amounts of various kinds and forms of hypochlorite chlorine compounds used, however, are not available.

Table 2

Growth in Chlorine-Exposed Population by Water Facilities Serving 25,000 or More Persons[2-4]

Year	Population in Group x 10^3	Plants Chlorinating		Population Served by Chlorinated Supply	
		No.	%	No. x 10^3	%
1948	61,864	465	96.8	59,442	96.1
1955	84,564	567	97.0	81,588	96.5*
1956	84,786	579	97.9	82,014	96.7**

*Equivalent to 97.5% of population receiving treated water
**Equivalent to 98.0% of population receiving treated water

Reactions in Water

The reactions involved in the addition of chlorine to water are not simple. All waters contain varying amounts of inorganic and organic materials of animal, vegetable, mineral or synthetic origin. Because chlorine is a strong oxidant, it dissipates itself rapidly in various side reactions with these materials and little disinfection is accomplished until most of these reactions are complete.

The addition of chlorine to pure water yields a mixture of hypochlorous (HOCl) and hydrochloric (HCl) acids

$$Cl_2 + H_2O \rightleftarrows HOCl + HCl$$
$$HCl \rightleftarrows H^+ + Cl^-$$

Above about pH 4, the equilibrium is displaced greatly to the right, and little or no Cl_2 exists in solution. HOCl is a weak acid and dissociates only poorly at below about pH 6. Between pH 6.0 and 8.5 there occurs a vary sharp change from undissociated hypochlorous acid to almost complete dissociation:

$$HOCl \rightleftarrows H^+ + OCl^-$$

Thus, chlorine exists predominately as HOCl at low pH levels; above about pH 7.5 hypochlorite ions (OCl^- predominate and exist almost exclusively at about pH 9 and above (See Figure 1).

As indicated in the previous article of this series the hypochlorite salt most extensively used in water treatment is so-called high-test calcium hypochlorite, $Ca(OCl)_2$. When this material is dissolved in water, ionization occurs:

$$Ca(OCl)_2 + H_2O \rightleftarrows Ca^{++} + H_2O + 2OCl^-$$

The hypochlorite ions establish equilibrium with hyrogen ions, depending on the pH, as indicated above. Thus, the same equilibria are established in water when chlorine is added in elemental, gaseous form or bound in a hypochlorite salt. The significant difference is in the effect of pH on the relative amounts of OCl^- and HOCl at equilibrium. Solutions of hypochlorite contain an excess of alkali which tends to increase the pH.

If ammonia or ammonium salts are present in the water, either naturally occurring or added, a combination of chloramines are formed depending on the relative amounts of chlorine and ammonia and the pH (See Figure 1):

$$NH_4^+ \rightleftarrows NH_3 + H^+$$
$$NH_3 + HOCl \rightarrow NH_2Cl + H_2O \quad \text{(monochloramine)}$$
$$NH_3 + 2HOCl \rightarrow NHCl_2 + 2H_2O \quad \text{(dichloramine)}$$
$$NH_3 + 3HOCl \rightarrow NCl_3 + 3H_2O \quad \text{(trichloramine)}$$

The chloramines are considerably weaker than hypochlorous acid and hypochlorite ions in their bactericidal, capacity, although mono- and dichloramines do exert a significant bactericidal effect. Also, while analogous reactions with organic ammonia compounds occur, the organic chloramine

Table 3

Disinfection Processes at U.S. Water Plants—1948[2]

Populations Served	Number of Plants		Chlorine Forms Employed			
	Total	Chlorinating	Hypochlorites	Gas	Both	Misc. or Unknown
<500	859	738	469	237	2	30
500-1000	1396	1148	554	519	6	68
1000-5000	2952	2576	489	1775	18	294
5000-10,000	747	695	29	508	6	152
10,000-25,000	552	515	14	331	1	169
25,000-50,000	193	188	1	102	4	83
50,000-100,000	102	102	0	51	0	50
>100,000	185	175	1	90	0	84
(Total)	6986	6137	1557	3613	37	930

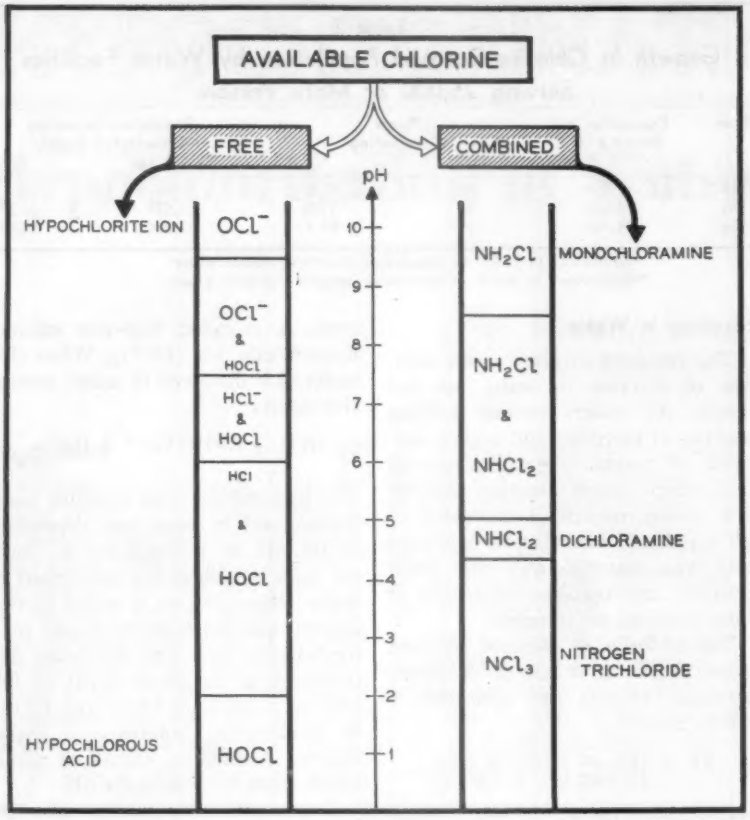


FIG. 1. RELATIONSHIP of pH to free and combined forms of available chlorine.

residual complexes formed have far less bactericidal capacity than both inorganic chloramines and free residual chlorine forms.

In addition, chlorine and its compounds react with a variety or other materials, particularly inorganic reducing agents such as hydrogen sulphide, iron (Fe^{++}), manganese (Mn^{++}) and nitrites (NO_2^-). Similarly, many chloro-addition or chlorine substitution reactions can occur with organic substances, or existing organic matter might be completely oxidized by chlorine. All of these reactions occur at different rates, and all tend to complicate the disinfecting process. The demand for chlorine for such purposes must be largely satisfied before any significant disinfection can be accomplished. Notwithstanding, this very high oxidative capacity of chlorine is responsible for its utility as a water treatment chemical for purposes in addition to disinfection [5] as demonstrated in Figure 2.

Free and Combined Chlorination

As previously noted, chlorine and hypochlorous acid react with ammonia in water to form various chloramine complexes termed combined available residual chlorine forms. If sufficient chlorine is added ammonia will eventually be destroyed and chlorine will exist as free available residual chlorine (HOCl, OCl^-, possibly Cl_2, and combination thereof depending on pH). The point at which the chlorine demand of ammonia and other chlorine-consuming materials has been satisfied, and beyond which free chlorine remaining (the residual) rises in direct proportion to the dose is called the *breakpoint*. The process of chlorination until the breakpoint is reached is termed *combined available residual chlorination;* that at and beyond the breakpoint (e.g. super-chlorination) is termed *free available residual chlorination*. Both processes satisfactorily employed will yield a safe water but both are not equally satisfactory for all water sources for disinfection and other treatment objectives. Similarly, both processes can be achieved by using gaseous chlorine or hypochlorite chlorine forms, but economy, convenience of operation and other factors sometimes dictate a preferential material.

Chlorination Principles

To ensure freedom from pathogenic bacteria it is necessary to provide a certain residual or excess of chlorine at the end of a specified minimum period of time after chlorination. Thus, two factors are extremely important: time of contact and concentration of the disinfecting agent (and, thus, the character and magnitude of the residual). These largely are reciprocally interdependent and depend on such factors as pH, temperature, organic pollution and the presence of ammonia and other nitrogenous materials capable of forming chloramines. In general, low pH accelerates, low temperature retards, and the presence of ammonia, amino and other organic materials diminishes the bactericidal potential of available chlorine, in either free or combined form.

To accomplish satisfactory disinfection without adding that amount of chlorine (in one of its various forms) necessary to reach the breakpoint, sufficient contact duration must be provided for chloramines and other chlorine complexes to exert their bactericidal effect. This duration is substantially greater than that necessary for free chlorine forms. About 25 times more chloramine than free chlorine is necessary during the same contact period, and about 100 times more contact duration is necessary at the same level of residual chlorine, to effect equivalent bacterial kills.

Beyond the breakpoint the chlorine dose usually is sufficient to sat-

Table 4

Disinfection Processes at U.S. Water Plants Serving 25,000 or More Persons[2,4]

Year	Number of Plants		Chlorine Forms Employed			
	Total	Chlorinating	Hypochlorites	Gas	Both	Misc. or Unknown
1948	480	465	2	243	4	217
1956	591	579	13	388	12	166

isfy the chlorine demand due to less-resistant bacteria and some readily oxidizable organic and inorganic constituents of the water, as well as to provide a slight residual of free chlorine to attack more resistant bacteria and react with more complex chemical impurities. The addition of substantial excess chlorine (super-chlorination) results in further satisfaction of the chlorine demand and oxidation of complex organics such as those contributing to color, taste and odor problems.

Free available residual chlorination is especially indicated where raw water quality is poor, for manganese (and sometimes iron) oxidation, for minimizing or controlling some difficult taste and odor problems, or where contact time with smaller amounts or less potent available chlorine forms is insufficient to effect satisfactory disinfection. Obviously the amount of chlorine necessary to achieve the breakpoint depends on the chlorine demand of the water being treated; some waters may require only 1 mg/l or less while others may require 10 mg/l or more. Practical and economic reasons then, to some degree, dictate the choice between elemental or hypochlorite chlorine forms especially where high free residual chlorination of a substantial quantity of inferior quality water is indicated.

Chlorine Gas vs. Hypochlorites

Among the factors influencing the selection of gaseous chlorine or of chlorine-containing compounds are: plant size and volume of water to be treated; characteristics of raw water, and treatment objectives; continuity of operation; safety considerations; availability and comparative costs of materials, facilities and personnel required for handling, storage and mantenance; effects on other processes; state, local or insurance requirements, and others. Many of these factors are interrelated and, except in those instances where material requirements obviously favor the use of gaseous chlorine, broad generalizations cannot be established and each situation should be considered separately on its own merit.

Where very large quantities of inferior quality water are to be treated, gaseous chlorine is the preferred material in most cases and economy generally dictates its use if not otherwise prohibited. (In some areas, for example, the use of gaseous chlorine as a swimming pool disinfectant is not permitted at small public or semi-public and private pools.) Furthermore, is such cases the advantages of gaseous chlorine usually far outweigh the possible disadvantages, and suitable responsibility usually is available to minimize safety hazards associated with the gas.[6]

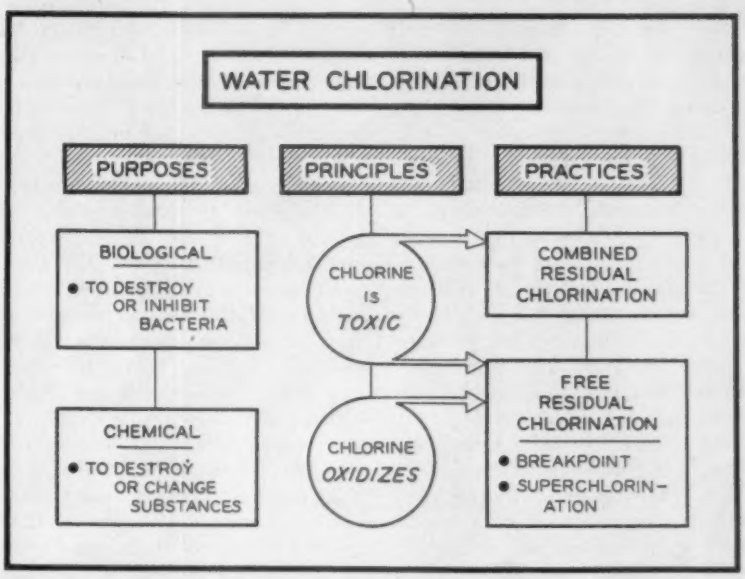


FIG. 2. APPLICATION of chlorine in water treatment.

Aside from the consideration of comparative basic costs and availability of materials, more extensive space requirements and storage facilities are required for hypochlorite handling than for gaseous chlorine, especially where chemical requirements are substantial. Moreover, inventory requirements for equivalent amounts of available chlorine must be considered in light of product

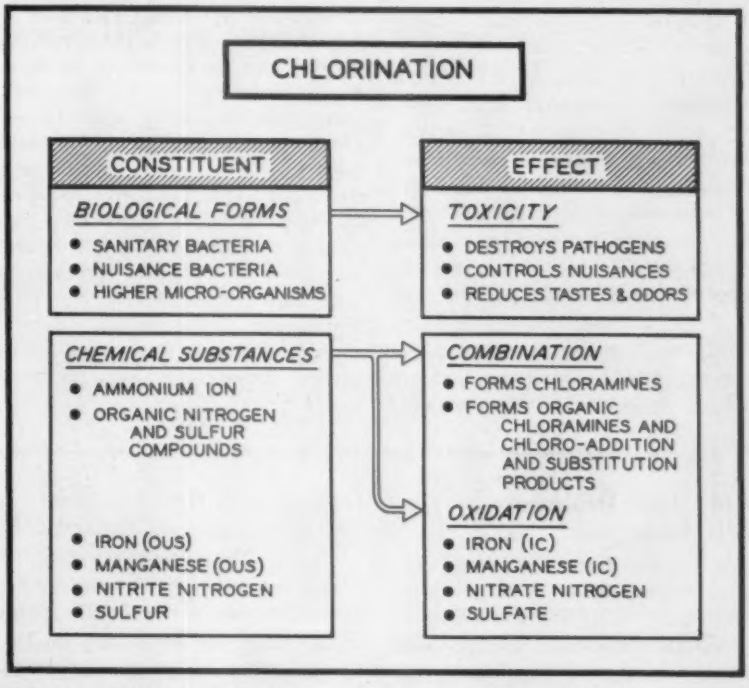


FIG. 3. TYPICAL biological and chemical effects of chlorine in water treatment.

stability and deterioration and ready availability of the chemical from nearby sources. This is particularly apparent in the case of sodium hypochlorite solutions. Because of their relatively lower stability, it is necessary to employ larger amounts of stored materials to accomplish the same objective. This involves regular and increasingly more frequent analytical tests of available chlorine content and resetting of hypochlorite feeders to provide the dosage necessary to accomplish the treatment objective. (For these reasons, the more stable, high-test calcium hypochlorite products have enjoyed greater popularity among water treatment authorities.) Where gaseous chlorine obviously is the disinfectant of choice, handling, inventory and storage requirements also must be related to the availability of and size of various approved chlorine shipping containers, but product deterioration need not be considered.

Feeders and appurtenances for granular, tablet and solution hypochlorites are considerably simpler and cheaper than liquid chlorine evaporators, gas feeders, scales etc. Here again, however, operating requirements and other conditions frequently favor one or another available forms of chlorine and offtimes precludes application of the remaining forms for practical or economic reasons alone.

Safety is one of the most important factors to be considered in establishing the relative merits of gaseous chlorine and hypochlorites. Many state and local authorities have rigid and extensive safety requirements that must be met where gaseous chlorine is employed. The record suggests that hypochlorites generally be employed at those facilities located indoors, where many persons do or are likely to congregate, or otherwise that are in quite close proximity to populated areas. In any event, for safety reasons the author advocates that gaseous chlorine not be approved for any facility unless the chlorination equipment is made and its operation carried on by and under the constant supervision of experienced personnel.

As noted previously, pound for pound of available chlorine applied under identical conditions, hypochlorites appear to be equally efficacious as gaseous chlorine for disinfection and other common chlorination objectives. Because chlorine hydrolyzes to form an hypochlorous and hydrochloric acid solution, the pH does tend to be lowered. (Actually each part of chlorine added consumes about 1.22 parts of alkalinity (as $CaCO_3$) and sometimes pH correction is indicated to control the aggressiveness of the water.) Hypochlorites usually contain excess alkalinity to increase their stability and have less effect on pH. Because the degree to which hypochlorous acid ionizes is a function of pH, and the efficacy of chlorine disinfection is related to the amount of free chlorine existing as hypochlorous acid rather than OCl^-, the effects of gaseous chlorine and hypochlorites on pH definitely influence the treatment results. In some hard water areas there exists the possibility of scale formation and associated problems resulting from the precipation of calcium carbonate by hypochlorites. (Such problems frequently can be controlled, however, by sequestering with sodium hexametaphosphate or by other means.) On the other hand, hypochlorite treatment may actually improve the quality of soft and highly corrosive waters for the same reason. While there may be such operating problems associated with hypochlorites, it is significant to note that equipment clogging, pipeline capacity reduction etc., allegedly caused by liquid chlorine impurities, present similar problems in some places.

Applications

In brief, hypochlorites can be successfully used for the same purposes for which gaseous chlorine is used in water treatment. While rules of thumb cannot intelligently be applied in selecting the most suitable material to do a job, experience indicates that hypochlorites are especially useful at public water treatment plants serving up to about 5000 persons (See Table 3); for disinfection of rural, airline, railroad, or other small private water systems; for disinfection of new and repaired pipelines, reservoirs and similar water system appurtenances; for disinfection of emergency water sources and on mobile water purification units; for standby chlorination; for treatment of ground water supplies during and subsequent to construction; for maintaining distribution system residuals and for slime and other nuisance organism control; for disinfection and algae control of swimming pools, regardless of size, but especially at public pools of 75,000-gal capacity or less, and all semi-public and private pools, and, for numerous other proven applications.

References

1. Porges, Ralph. The Background of Municipal Water Treatment. *Public Works* (Feb. 1958)
2. Thoman, John R. Statistical Summary (1948) of Water Supply and Treatment Practices in the United States. Public Health Service Publication No. 301. (1953)
3. Porges, Ralph. Summary of 1955 USPHS Survey of Treatment Facilities in Communities of 25,000 and Over. *J.A.W.W.A.*, 49:12 (Dec. 1957)
4. Thoman, John R. and Jenkins, Kenneth H. Inventory of 1956 Water Supply Facilities in Communities of 25,000 and Over. *J.A.W.W.A.*, 50:8 (Aug. 1958)
5. Laubusch, Edmund J. Chlorination of Water. *Water & Sewage Works*, 105:10 (Oct. 1958)
6. Laubusch, Edmund J. Chlorine Handling and Storage. *Water & Sewage Works*, 106:2 (Feb. 1959)

Acid Mine Drainage Kills Fish

Acid mine drainage, washed into the Allegheny River by heavy rains, was blamed today for the killing of several thousand fish between New Kensington and Pittsburgh earlier this week.

The Pennsylvania State Health Department said that first reports of the kill were received on Wednesday (July 6). The Department reported that investigation by its Sanitary Engineers showed a rise in the acidity of the Allegheny River early on July 5, traceable to a 2-inch rainfall on the acid Kiskiminetas River and its tributaries on July 2.

Dick C. Heil, Health Department Sanitary Engineer at Pittsburgh Regional Headquarters, who is directing the investigation, said that "this kill almost directly parallels the similar kill of June, 1958, which was traced to acid mine drainage from abandoned coal mines on the 'Kiski' watershed, washed into the streams in large concentrations by heavy rains."

Of special interest to those who have sampling collection problems is . . .

Automatic Sewage Sampling at Charlottesville, Va.

By C. G. HANEY, Supt.
Water & Sewage Treatment

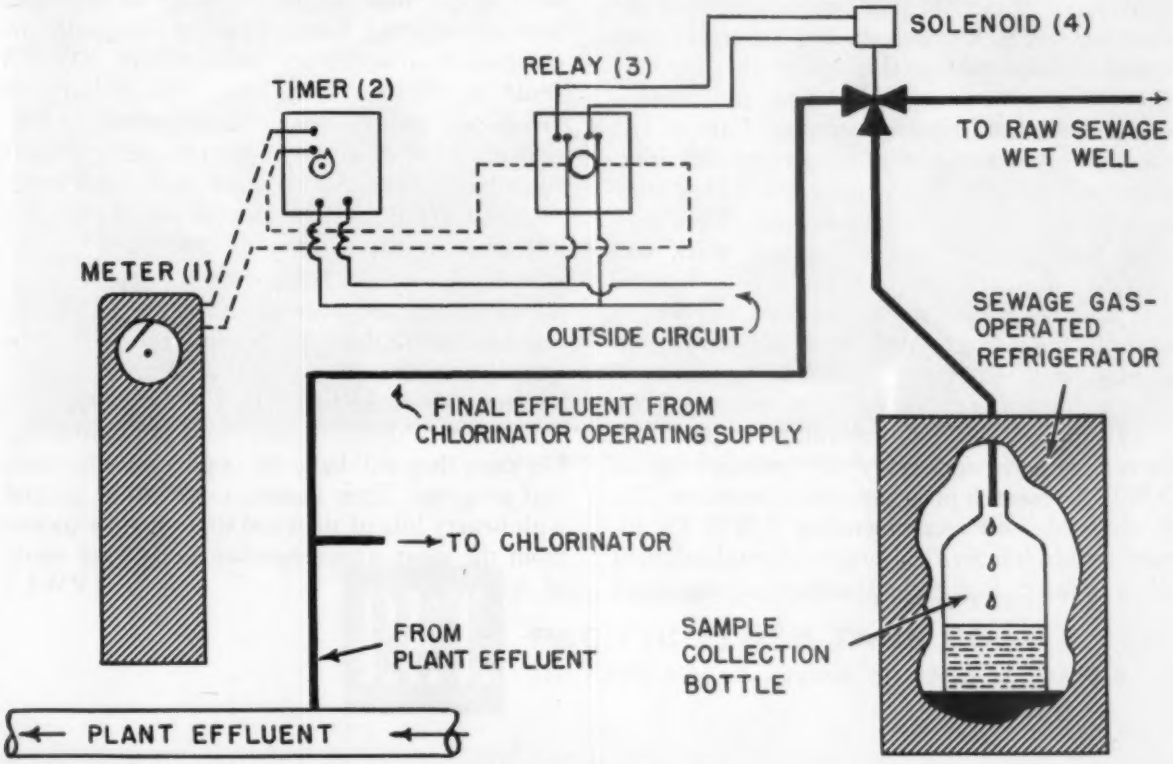
■ SINCE OUR PLANT was put into operation in 1957, our operators and the State agencies have suggested automatic sampling of our effluent. Prior to January 1960, all B.O.D. samples were grab samples taken during the low peak flows.

In order to find a suitable type automatic sampler, several of the ones now on the market were considered. But with out plant layout, we did not feel that they would give us the information we wanted. We tried taking samples manually in proportion to the flow every two hours, but found that there would be times when the operator (one on duty) would be suddenly faced with operational difficulties, and the samples would then be necessarily neglected.

After checking the operation of our plant effluent meter, (B.I.F. Chronoflo with parshall flume), we decided to experiment with a sampler of our own design. Our meter transmitter operates on a 15 second cycle, with a maximum signal of 13.3 seconds. The signal time varies with the flow. At our plant we use the plant effluent to operate the chlorinator, so we tapped this line to take samples. In order to take fresh samples, we installed a by-pass solenoid valve. When samples are not being taken, there is a continuous flow through the solenoid valve, and this flow is returned to the raw sewage wet well to help keep the floats clean. The length of time and the frequency of sampling is made by the setting of a timing device. We take samples four minutes out of each hour. To preserve the sample, we installed a gas-operated refrigerator which operates on sewage gas.

To keep the extra load off the mercury switch in the meter transmitter, we use the current only to operate the solenoid on a relay. To operate the solenoid and timer, the current is taken from another source.

The operation of the sampler is as follows: The signal from the meter (1), is connected to the relay (2), and one of these wires goes through the points on the timer (3). When these points are closed by the clock cam, the relay points are closed. When this relay is closed, the current flows to the by-pass solenoid (4), closing the by-pass and letting a sample flow into the sample jar. The above cycle takes place four times per minute until the clock cam moves enough for the points on the clock to open.



SCHEMATIC DIAGRAM showing details of automatic sewage sampler

EDITORIAL

AWWA's Aims and Objectives

There is slight doubt that the major AWWA accomplishment at Bal Harbour was submission of the final Aims and Objectives Committee report by Chairman F. A. Eidsness. The real impact of the report cannot be judged here, because it was submitted to the AWWA Board of Directors in closed session immediately following the official meeting. One thing must be terribly clear to AWWA's "official family" and to the Board: ten out of twelve A & O sub-committees fired up enough ideas and suggestions to cause considerable head scratching. In fact, one wonders why the move was necessary at all? Why should so many areas of AWWA activity need so much attention? The answers may not be readily apparent, but it has been made forcefully clear that some areas need attention and the attention is needed now.

For example, Sub-Committee No. 4, which considered Materials and Equipment, reviewed existing AWWA standards and suggested some changes. Importantly, this group also reported that present methods of handling standards is cumbersome and time consuming. Part of this recommendation aimed at improving this function was that AWWA employ a full-time engineer to work in the standards field. This engineer would coordinate committee work and expedite standards preparation. It was reported that this recommendation has been acted upon favorably, putting AWWA in the market for a Standards Engineer, undoubtedly a timely and important step forward.

Several of the Sub-Committee reports referred to the necessity of commencing an AWWA research program. Sub-Committee No. 8, charged with recommending AWWA's future research activities, proposed establishment of a Water Research Institute, independent from but affiliated with, AWWA. Unfortunately, the establishment of a full-fledged Water Research Institute is presently outside the scope of AWWA's budget, perhaps even outside the scope of AWWA's Constitution. Recognizing this, A & O Chairman Eidsness proposed that AWWA Directors form a committee among themselves to find ways and means to generate a research organization. If fault can be found with this procedure, it lies in the waste of precious time in getting started doing what ought to have begun years ago.

It is recognized that much research of interest and importance to AWWA is presently being carried on. But where, how and by whom? One suggestion at Bal Harbour was that the prerequisite to coordinating water research activities and arranging a research program consisted of preparing a research inventory. Why not? Begin now to assemble all known data into one clearing house. Having eventually accumulated all necessary information, AWWA could by then certainly have figured out how much each utility, consulting engineer and participating industry should contribute as its fair supporting share. Actually, while the total funds required are large, the annual per capita cost has been estimated at one cent.

With the several sub-committee reports completed and turned over as recommendations by the Aims and Objectives Committee, it is to be hoped that the AWWA Board of Directors will not "drop the ball." In January 1961 they will travel to their Annual New York Meeting. For once they will have the opportunity to chart real progress. Their agenda ought to be packed with hearty bits of material thoughtfully picked from the most comprehensive study ever made of AWWA. (VWL)

Nestled among some of the most beautiful hills surrounding busy metropolitan Pittsburgh is the attractive community of Pleasant Hills, Pennsylvania.

This rapidly growing suburban area is not only providing gracious living for its residents but also effective and modern sewage treatment facilities.

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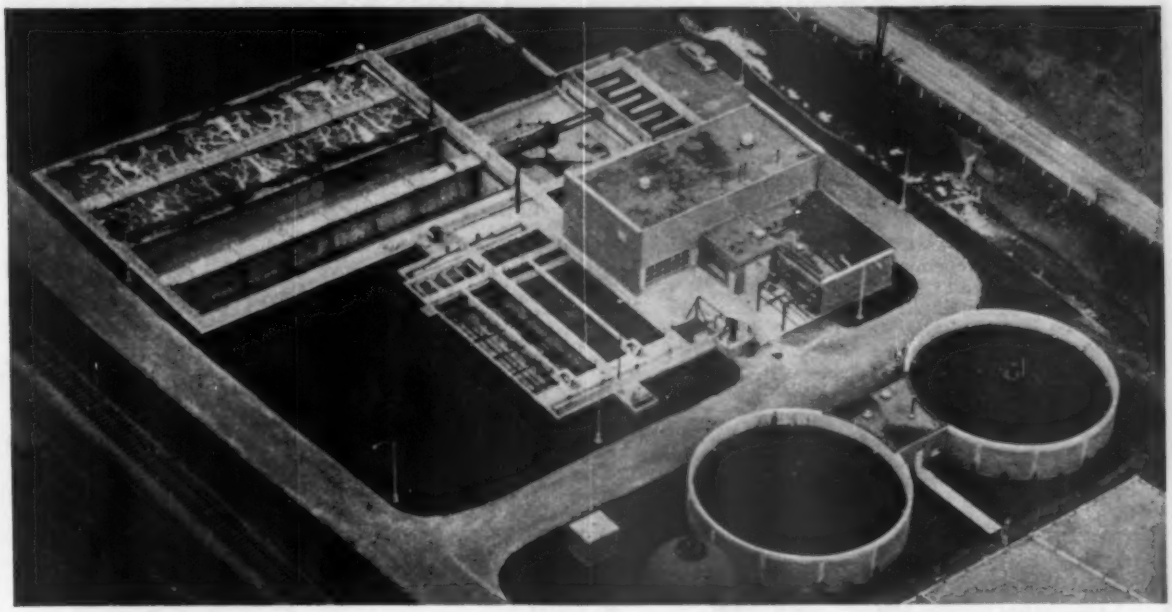
Pleasant Hills will dedicate its new plant this year. P.F.T. congratulates the community and its civic leaders for their progressive thinking and planning.

Pleasant Hills



Aerial shows P.F.T.'s two 65′ Floating Covers at new plant

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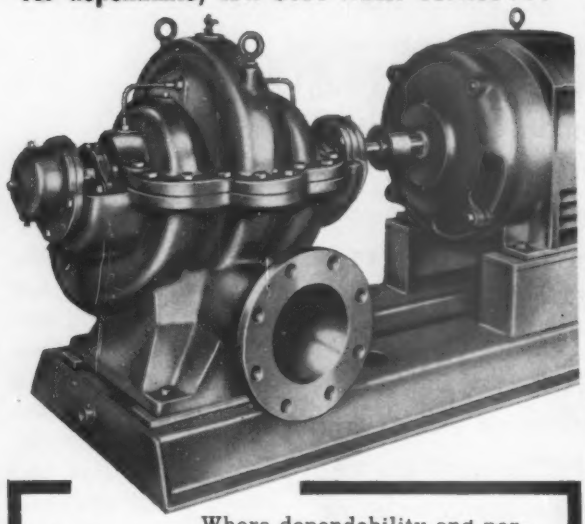

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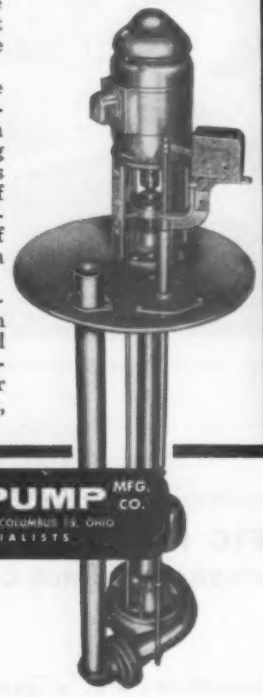

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OCTOBER							NOVEMBER							DECEMBER						
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Aug. 10-12—University Park, Pa. (*Pa. State University*) PA. SECTION WATER POLLUTION CONTROL FEDERATION

Aug. 22-26—Boulder, Colorado (*University of Colo.*) WESTERN RESOURCES CONFERENCE

Aug. 29-31—Cincinnati, Ohio. (*Sanitary Engineering Center*) Public Health Service Symposum on Water Quality Data Collection and Utilization. Director, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, Ohio

Sept. 7-9—Watertown, South Dakota (*Grand Hotel*) SOUTH DAKOTA SECTION WATER POLLUTION CONTROL FEDERATION

Sept. 7-9—Watertown, South Dakota (*Grand Hotel*) So. DAKOTA SECTION A.W.W.A. Secy., J. Darrell Bakken, Div. of San. Eng., State Dept. of Health, Pierre, S. D.

Sept. 11-16—New York, N. Y. AMERICAN CHEMICAL SOCIETY

Sept. 12-14—Knoxville, Tenn. (*Andrew Jackson Hotel*) KENTUCKY-TENN. SECTION A.W.W.A. Secy., Harold F. Mount, Gen. Mgr., Preston Street Road Water District No. 1, 5400 Preston Highway, Louisville. Ky.

Sept. 12-14—Knoxville, Tenn. (*Andrew Jackson Hotel*) KENTUCKY-TENN. SECTION WATER POLUTION CONTROL FEDERATION

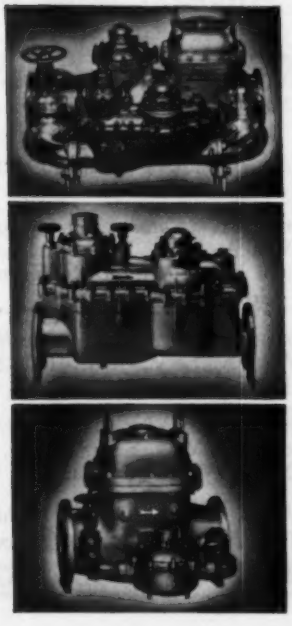
Sept. 14-16—Virginia Beach, Va. (*Cavalier Hotel*) VIRGINIA SECTION A.W.W.A. Secy: Edward H. Ruehl, R. Stuart Royer & Assoc., 15 West Cary St., Richmond, Va.

Sept. 14-16—Upper Saranac Lake, N. Y. (*Saranac Inn*) NEW YORK SECTION A.W.W.A. Secy., Kimball Blanchard, New York Branch Sales Office, Neptune Meter Co., 22-22 Jackson Ave., Long Island City 1,

Sept. 18-21—Montreal. Quebec (*Queen Elizabeth Hotel*) 1960 Annual Convention NEW ENGLAND WATER WORKS ASSN.

(CONTIUED ON PAGE 74A)

NO ADDITIONAL PRESSURE IS REQUIRED BY THE HERSEY COUNTERBALANCED LEVER VALVE



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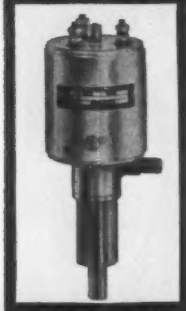
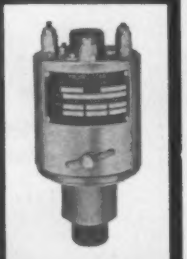


1 Switch
UNDERSPEED OR OVERSPEED

2 Switches
UNDERSPEED AND OVERSPEED



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2101 N. Webster St., Kokomo, Ind.

(CONTINUED FROM PAGE 72A)

Sept. 21-23—St. Paul, Minn. (*Lowry Hotel*) North Central Section A.W.W.A. Secy., Carl A. Flack, Registrar, Water Dept., 216 City Hall, St. Paul, Minn.

Sept. 21-23—Traverse City, Mich. (*Park Place Hotel*) Michigan Section A.W.W.A. Secy., T. L. Vander Velde, Chief, Section of Water Supply, State Dept. of Health, DeWitt Rd., Lansing, Mich.

Sept. 25-27—Jefferson City, Mo. (*Hotel Governor*) Missouri Section Water Pollution Control Federation

Sept. 25-27—Jefferson City, Mo. (*Hotel Governor*) Missouri Section A.W.W.A. Secy., Warren A. Kramer, Chief, Water Supply, Div. of Health, State Office Bldg., Jefferson City, Mo.

Sept. 25-28—Tulsa, Okla. (*Mayo Hotel*) American Institute of Chemical Engineers

Sept. 28-30—Madison, Wis. (*Hotel Loraine*) Wisconsin Section A.W.W.A. Secy., Harry Breimeister, Bureau of Engineers, 607 Municipal Bldg., Milwaukee, Wis.

Sept. 28-30—Charlottetown, P.E.I., Canada (*Charlottetown Hotel*) Maritime Branch, Canadian Section A.W.W.A. Secy., J. D. Kline, Gen. Mgr., Public Service Com., Halifax, N. S.

Oct. 2-6—Philadelphia, Pa. (*Hotel Sheraton*) Thirty-Third Annual Meeting Water Pollution Control Federation

Oct. 2-9—Montivideo, Uruguay (*Hotel Carrasco*) Interamerican Assn. of Sanitary Engineering. Write: J. G. Stewart, Room 2008, 165 Broadway, New York 6, N. Y.

Oct. 5-7—Bismark, North Dakota (*Grand Pacific Hotel*) North Dak. Section Water Pollution Control Federation

Oct. 6—Hamden, Conn. (*Sanford Barn*) Conn. Section A.W.W.A. Sec., Donald W. Loiselle, Supt. of Supply, Bridgeport Hydraulic Co., Bridgeport, Conn.

Oct. 9-12—Birmingham, Ala. (*Tutwiler Hotel*) Ala.-Miss. Section A.W.W.A. Secy., Ernest Bryan, McWane Cast Iron Pipe Co., Box 2601, Birmingham, Ala.

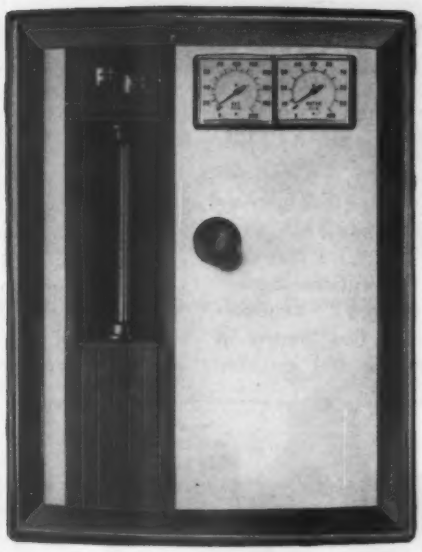
Oct. 9-13—Boston, Mass. American Society Civil Engineers

Oct. 16-19—Galveston, Tex. (*Galvez Hotel*) Southwest Section A.W.W.A. Secy., Leslie A. Jackson, Mgr.-Engr., Municipal Water Works, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 19-21—Des Moines, Iowa (*Fort Des Moines Hotel*) Iowa Section A.W.W.A. Secy., J. J. Hail, Supt., Water Dept., City Hall, Dubuque, Iowa.

Oct. 19-21—Washington, D. C., (*Sheraton Park Hotel*) Chesapeake Section A.W.W.A. Secy., Carl J. Lauter, 6955-33rd St., N.W., Washington, D. C.

Oct. 20-22—Walla Walla, Wash. (*Marcus Whitman Hotel*) Pacific Northwest Pollution Control Association G. H. Dunstan, Secy., Box 176, Pullman, Wash.



This, believe it or not, is a wall mounted chlorinator. Its attractive appearance is our way of showing how proud we are of the advanced operating parts hidden behind the front panel. For example: This is the first wall mounted chlorinator ever to feature a single stack regulator. Simple, compact appearance belies the fact that it can handle up to 200 pounds per day of chlorine more accurately, dependably, and safely than any other chlorinator with the single exception of its big brothers. It is so completely corrosion-proof in the right places that we have little hope of ever selling replacement units. In short, we have never been happier with any product than we are with the new Series 3600 chlorinators.

Should you wish to order one of these beauties sight-unseen, on our say-so, we can deliver immediately from warehouse stocks across the country. If not, your local F&P field office will gladly demonstrate the 3600 Series at your plant, at your convenience. Call for an appointment. Or, write for complete information in Bulletin 70C3600. Fischer & Porter Company, 180 Fischer Road, Warminster, Pa.

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Equipment News

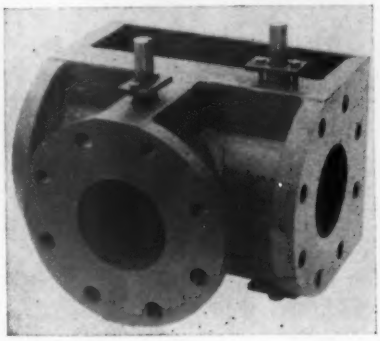
CONTINUED FROM PAGE 21A

New Unit Replaces Two Butterfly Valves and a "T"

808

United States Valve & Engineering Company, Houston, Texas, has developed a new 2-in-one valve that does the work of two conventional butterfly valves and a flanged "T" connection. It gives perfect flow control in cooling water systems and in other applications where two streams flow to or from a single pipe.

Besides replacing the costlier assembly of two valves and a "T", the U.S. Triangle Valves is easier to install and to maintain. It fits piping arrangements with ease, requires no awkward alignment and adjustment. Shaft packing may be removed from either end of the through shaft, inspected, replaced or adjusted without removing the valve. The U.S. Triangle Valve is a single unit—two of the world's finest no-thrust vibration-



proof butterfly valves in a flanged "T" body.

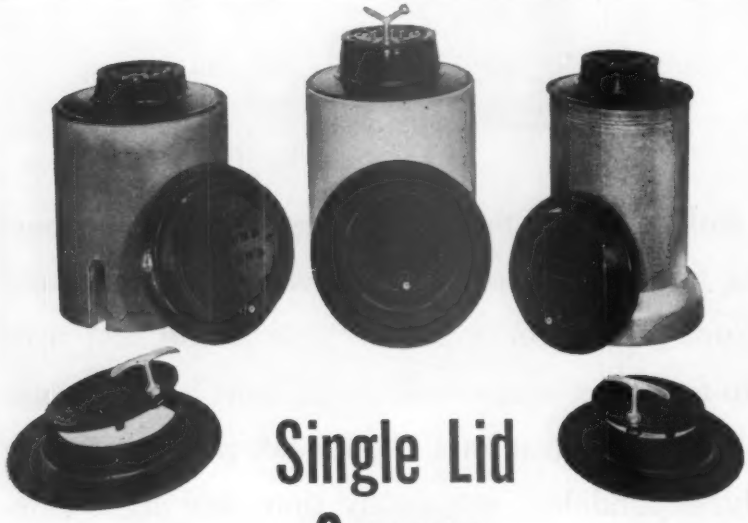
The Triangle Valve is constructed of corrosion resisistant materials and comes with either metal-seated or positive-sealing, Neoprene-seated valves. Bodies are manufactured to dimensions of ASA Class 125 cast iron flanged fittings, ASA B 16a. Available in sizes 1" through 12".

Miniature Shutoff Valve

809

The Circle Seal Products Co., Inc., Pasadena, California has introduced a new miniature leakproof shutoff valve designed for use in vacuum or pressure service, and which incorporates an O-ring principle that makes the valve leak-proof and easy to operate. Repair can be made quickly without removing valve from the line, and it's convenient "T" handle is color-coded for gas or liquid service such as oxygen, air, nitrogen, hydraulic fluids, water, oil and many others. Some typical applications of the valve include instrumentation, inert gas test stands and hydraulic clamps.

The new valve features an O-ring on the cylindrical face of the straight plug which prevents leakage past the inlet port as well as the critical stem area. A quick glance at the "T" handle position instantly tells the exact valve position. A quarter turn is all that is required from full open to dead tight close. No spring is used; no complicated adjustments are necessary. O-ring seals virtually eliminate wear. The valve can be used for metering by turning the handle between full on and off positions. It is available in brass of stainless 303 with either male or female connections in ⅛" or ¼" size.



Single Lid Covers

FOR WATER METER SETTINGS

Type C Single Lid Ford Meter Box Covers provide meter readers and service men with easy access to water and gas meters set below grade. These strong covers, with overlapping lids, are made with 8" to 15" lid openings and are sized to fit standard 15" to 21" I.D. tile. Extra heavy covers are made in three sizes for street and driveway installations. All have the Lifter Worm Lock with forged silicon bronze bolts.

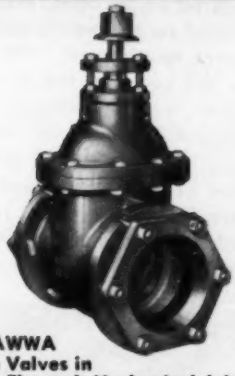
FORD for *better* water services

THE FORD METER BOX COMPANY, INC., Wabash, Indiana

IOWA

meets your most exacting specifications

FOR FLOW CONTROL: *in distribution and fire protection systems*



AWWA
Gate Valves in
Hub, Flanged, Mechanical Joint

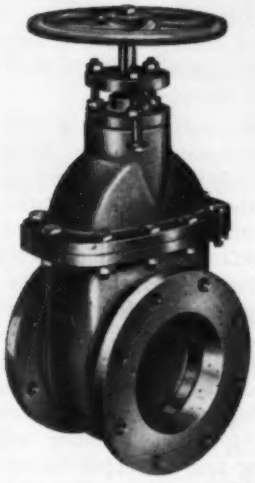
to connect branch mains under pressure

Mechanical Joint
Tapping Valves
and Sleeves

to insert valves into existing line

Mechanical Joint
Cutting-in Valves
and Sleeves

FOR FLOW CONTROL: *in sewage treatment and water filtration plants*



Flanged Gate Valves
2" through 42"

Flap Valves

Plug Drain Valves

Sluice Gates

Shear Gates

Check Valves

Square-Bottom Valves

Few manufacturers can match *Iowa* in offering such a wide variety of valves, accessories and specialties for water filtration and sewage treatment plants, as well as for water distribution systems. It will pay you to call in an *Iowa* man before placing your order!

IOWA VALVE COMPANY

Oskaloosa, Iowa • *A Subsidiary of James B. Clow & Sons, Inc.*

Since 1909 a reliable source for precision engineered products

catalog on request

News of Suppliers

Hicks Named Centriline Philadelphia Manager

Centriline Corp., of Raymond International, Inc. New York, New York, has named Arthur S. Hicks as district manager for their Philadelphia area. The company specializes in the renovation of underground pipe lines by cleaning and lining.

Mr. Hicks was previously manager of water line sales for Dresser Manufacturing Division, Dresser Industries, Inc. He is a member of the American Society of Civil Engineers, American Water Works Association, New England Water Works Association, Pennsylvania Professional Engineers, and the Pennsylvania Sewage and Industrial Wastes Association.

This year is your 25th anniversary. It's twenty-five years since you asked for corrosion prevention. It's twenty-five years since Electro Rust-Proofing designed and installed your first cathodic protection system.

ERP has expanded in those years. Today, ERP's worldwide organization protects pipelines, water towers, clarifiers, docks, ships' ballast tanks, and other submerged and buried metals. We've improved our methods . . . pioneered new equipment . . . brought automation to cathodic protection.

We're working now to give you even greater value, even better service for your cathodic protection dollar. To us, this milestone is not a monument. It's a stepping stone towards a corrosion-free future—with ERP.

To those who don't yet know us—we'll be happy to meet you. Just write to Dept. E-53.94.

ERP CATHODIC PROTECTION SINCE 1935

ELECTRO RUST-PROOFING CORP.
A SUBSIDIARY OF WALLACE & TIERNAN INC.
30 MAIN STREET, BELLEVILLE 9, NEW JERSEY
CABLE: ELECTRO, NEWARK, N. J.

Mueller Announces Modernization and Expansion Program

Mueller Co., Decatur, Ill., has announced a major modernization and expansion program for the company's plant in Decatur.

The program, the estimated cost of which is more than five million dollars, will replace more than half of the structures in the area bounded by the Wabash tracks on the north, Monroe Street on the west, West Eldorado Street on the South, and Edward Street on the east. The new buildings will be connected to existing facilities west of Monroe by a new underground pedestrian tunnel.

New construction will add 261,500 square feet of floor space, and 43,-300 square feet of space will be rehabilitated. Approximately 96,000 square feet of land will be cleared of buildings and left vacant.

Sverdrup & Parcel Engineering Company, a nationally-known firm of engineer-architects in St. Louis, has been engaged to develop the preliminary studies, plans, specifications and cost estimates for the expansion program.

Target date to call for bids is August, 1960, and construction is expected to be completed in 16 to 24 months after the bid-letting.

A new, air conditioned office building of contemporary design, facing West Eldorado Street, will provide space for the company's executive, general administrative and sales offices. A steel and brick one-story manufacturing and warehouse building extending from Monroe Street to Edward Street across two existing parking lots will be directly behind, and connected with, the new office building. An unusual feature of this 789-foot long building will be a parking area for approximately 450 automobiles on the roof.

Direct access to the plant and the office building will be provided from the roof parking area. This building will connect with three existing manufacturing buildings, as well as with the new shipping and receiving building.

In addition to the cost of new construction and renovation, company officials stated that approximately $1,000,000 will be expended for additional production and material handling equipment.

CONTINUED ON PAGE 80A

Rex PIVOTED Bar Screens

Provide Maximum Flexibility for Los Angeles County Plant

In the Los Angeles County Sanitation District No. 2 Sewage Treatment Plant at Harbor City, a new concept in screening operations has assured a new high in efficiency and flexibility...a new low in operating and maintenance costs...REX PIVOTED BAR SCREENS.

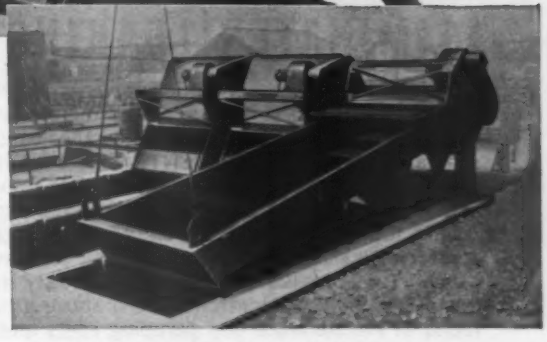
Close-up view showing screen suspended in channel. Note neat appearance... totally enclosed, streamlined housing and "straight-through," unobstructed flow.

Five Rex PIVOTED Bar Screens at Los Angeles County, Harbor City Plant. Channel width, 6½ feet; channel depth, 16 feet. Two screens each handle a flow ranging from 30 to 89 m.g.d. Three screens each handle flows of 42 to 127 m.g.d.

With this advanced design, each screen is pivoted so that it can be easily swung out of the channel for inspection and servicing. No need to dewater the channel...no need to shut down operations. Screens are back in service in a hurry.

FRONT CLEANING... front-mounted rake is held firmly in place... provides maximum shelf for carrying capacity. Positive, complete cleaning of tops and sides of bars to their full depth. Rakes *and* teeth clean the bars. No chance for rakes to slide over, or miss, screenings. Bar rack is held firmly in place at top and bottom to maintain uniform spacing.

MAXIMUM EFFICIENCY. Full 60-degree inclined racks mean greater rack area exposed to the flow. Dead plate from bar rack to point of discharge eliminates spillage...no screenings on downstream side. Chain Belt Company, 4610 W. Greenfield Ave., Milwaukee 1, Wis.



Screen pivoted out of channel. Pivot shaft rides in heavy-duty angle pillow blocks mounted on concrete pedestals.

REX®

CHAIN BELT COMPANY

News of Suppliers

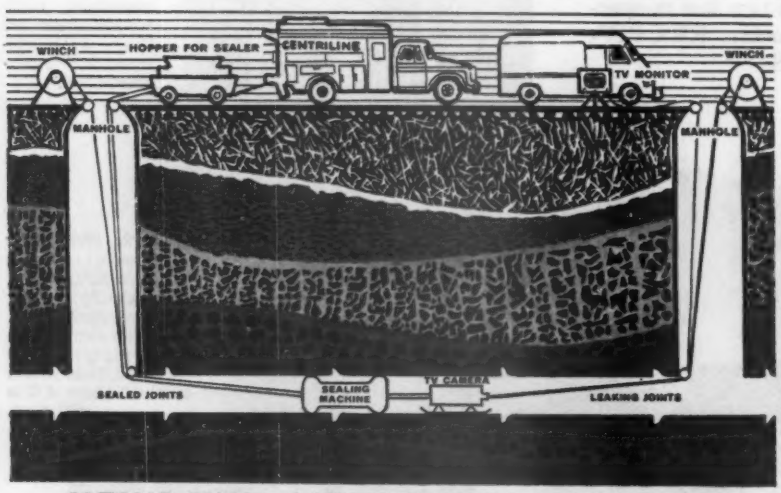
CONTINUED FROM PAGE 78A

Permutit Acquires Water Treatment Line

Permutit Company, Division of Pfaudler Permutit, Inc., New York, N. Y., has acquired all rights in the western hemisphere from R. P. Moore & Co. Ltd., of Johannesburg, South Africa, to manufacture and market a line of large capacity fluid clarifiers for water and waste treatment.

The new type "M" (Moore) precipitators are designed to remove impurities from water used in large volume by public utilities and municipal water works, chemical and petroleum plants, textile and paper mills, and other process industries. The design of these units, which are classed as sludge blanket precipitators makes them adaptable to many existing fluid treatment basins as well as for new applications.

The new precipitator is already set up for production at the company's Lancaster, Pa., plant where the first unit is being completed for shipment to an industrial customer. The new line will be sold through Permutit's present industrial sales engineering organization. The licensing arrangement was negotiated through the facilities of Pfaudler Permutit International Division.



NEW! THE CENTRISEAL PROCESS ELIMINATES LEAKING JOINTS

Now joint leakage can effectively be stopped in small as well as large sanitary and storm drains. By remote control—constantly monitored by television which finds the leaks and checks the seal afterwards—special CENTRISEAL PROCESS equipment forces a fast-setting polymeric sealer into open joints **from the inside.** This forms a tough seal in the pipe joint as well as outside in the surrounding soil. You're thus assured a permanent bond, and leakage from either internal or external pressures is prevented. No excavations are necessary and the grouting process is remotely controlled from above ground. Savings are found in maintenance and pumping costs and capital expenditures are avoided.

INCIDENTALLY... If your problem is more than leaking joints, if you have deteriorated pipes, investigate the other Centriline services. The CENTRILINE PROCESS lines pipes with a cement mortar or acid-resistant epoxy mortar applied centrifugally. Because the pipes remain in place, there's no traffic interruption. Pipe life is increased, ground and pavement settlement due to infiltration eliminated. Write now for complete information on the CENTRISEAL PROCESS for leaking joints and the CENTRILINE PROCESS for lining pipe.

CENTRILINE CORPORATION

Subsidiary of Raymond International Inc.

140 CEDAR STREET, NEW YORK 6, N. Y. • WOrth 2-1429

Branch Offices in Principal Cities of the United States, Canada and Latin America

Fraser Promoted by C B & I

Chicago Bridge & Iron Co., Chicago, Ill., has announced the appointment of Edward S. Fraser as Vice President in charge of Manufacturing.

Mr. Fraser has been in charge of the company's manufacturing operations for the past six months. Previously, he served as assistant general sales manager of the company, as manager of its Salt Lake City Plant and as an engineer in Chicago.

He joined CB&I in 1939, and is a member of the American Society of Civil Engineers, American Society for Testing Materials, and the American Management Association.

Carcus Chemical Iniates American Production of Water Treatment Chemical

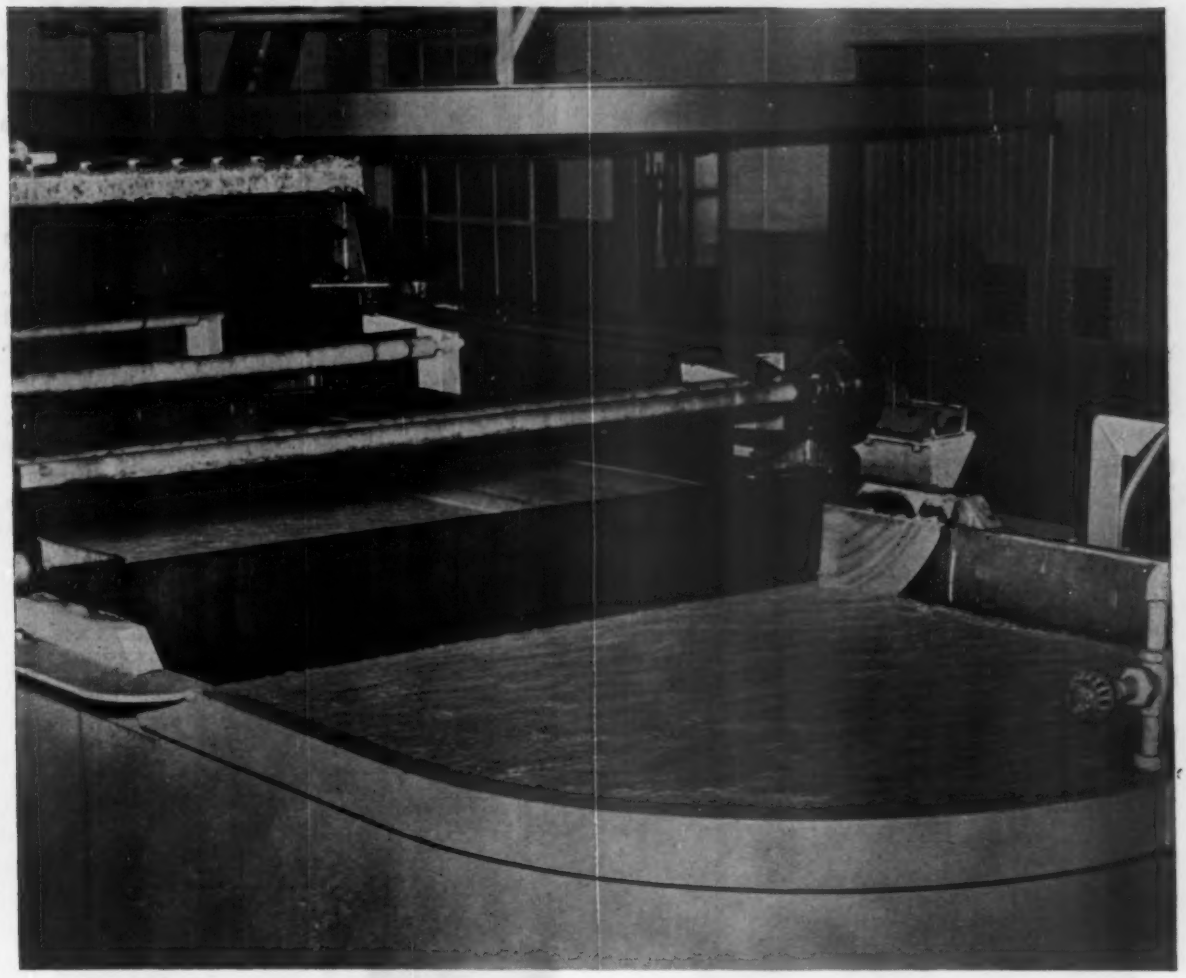
Carus Chemical Co., Inc., La Salle, Ill., sole American producer of potassium permanganate, announces the opening of its new End-Use Research Laboratory to develop and evaluate processes using the company's products in the treatment of drinking water.

Potassium permanganate is used in municipalities, industry and homes as a means of removing iron, manganese, hydrogen sulfide, mercaptans, and tastes and odors cased by industrial and human wastes, and algae.

Potassium permanganate serves as a coagulant aid, tending to minimize alum requirements, and serves effectively as a killer of microbiological growth, such as bacteria and coliforms.

Technical personnel of the End-Use Research Department are available for consultation and field assignments.

FLUIDICS* AT WORK



How this company cuts oil to less than 10 ppm in waste waters

You're looking at waste water being treated at International Harvester's plant at Fort Wayne, Indiana.

This water holds soluble and insoluble oils, alkaline cleaner fluids, mineral acids, corrosive salts and other contaminants. The quantities of these compounds vary from hour to hour, so the waste is sometimes predominantly acidic, sometimes predominantly alkaline.

Yet the single piece of equipment you see here, plus its accessories, takes this waste water and treats it so thoroughly it can be safely pumped into an open stream. Oil, for example, is reduced to less than 10 ppm. If it were necessary, the oil could be reduced to less than 1 ppm by further treatment.

How it is done

The single unit that makes these results possible is the Permutit Colloidair Separator.

It uses a relatively low-cost "bubbling out" process to remove wastes.

Air is forced into solution with the waste waters, under pressure. The mixture is then released to atmospheric pressure, causing the air to form millions of tiny bubbles, which collect around the solids and lift them to the surface of the tank, where they can be skimmed off and dumped into a disposal pit.

The Colloidair Separator is effective for processing solutions containing clays, greases, fibers, oils, paints, fats and many other suspended solids.

If you would like to find out more about the economies and efficiency of the Permutit Colloidair system, send for a copy of our Bulletin 4511.

Permutit Division, Dept. WS-80, 50 West 44th St., New York 36, N. Y.

*FLUIDICS is the Pfaudler Permutit program that integrates knowledge, equipment and experience in solving problems involving fluids.

PFAUDLER PERMUTIT INC.

Specialists in FLUIDICS ... the science of fluid processes

New Bulletins

AVAILABLE FREE

Wet Test Meter Bulletin

810

American Meter Company, Erie, Pa., has just published a new bulletin that provides full details on the company's Wet Test Meters which range in capacities to 1200 cfh and 150 l/m.

Included in the new bulletin are data on capacities, calibration, indexes, dimensions and special models available. Design features, construction materials and performance data are also covered.

Centrifugal And Turbine Type Pumps

811

Aurora Pump Division, The New York Air Brake Company, Aurora, Ill., has released a 4-page, condensed bulletin that illustrates and describes their centrifugal and Apco turbine type pumps; single and multiple stage, flexible and close coupled, horizontal and vertical models. Included in the brochure are brief descriptions, features, typical applications, capacity and head range for each type of pump.

Salient design features include: vertical mountings for minimized space requirements, dynamic and hydraulic balance, Mono-vane single passage impellers for non-clog applications, and centerline discharge for self-venting. Capacities range from 1 to 9000 G.P.M. and heads to 600 feet.

Priceless Water Promotion Folder Available

812

Johns-Manville Corp., New York, N. Y., has made available to all interested municipalities and community officials a folder for use in promoting painting the message PRICELESS WATER on elevated storage tanks.

The 4-page folder describes the general purposes of the "Priceless Water" campaign of the A.W.W.A. and gives specific questions and answers outlining the value of painting the term on elevated storage tanks. Written for the Water Utility Manager, "Priceless water storage Tank" folder outlines several steps that such officials can take to further this campaign within their own area of responsibility.

Auger for Soil Sampling

813

Acker Drill Co., Scranton, Pa., has published an 8-page bulletin that describes and illustrates its "ap", (all purpose) auger that is especially suitable for soil sampling application.

Pictures of the unit in action are featured in the bulletin, and the various accessories that make the unit even more versatile are also presented. The dimensions, specifications and performance data of the unit are provided.

Technical Data On Mercury Switches

814

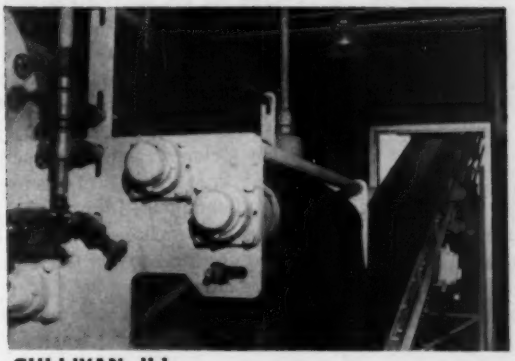
Gordos Corporation, Bloomfield, N. J., has issued a new 8-page tech-

CONTINUED ON PAGE 84A

McDONALD'S 104 YEARS OF EXPERIENCE STAND BEHIND THIS PRODUCT

McDonald 4717 Curb Stop — Minneapolis pattern. Combined cap and tee handle inverted key curb stop. Both ends copper pipe couplings. Round way. Also available in stop and drain patterns. Sizes — ½, ¾, 1, 1¼, 1½ and 2 inches. A catalog of McDonald's complete line of water works brass goods is available on request. Write to:

A.Y. McDONALD MFG. CO. Dept. WS-860, 12th & Pine, Dubuque, Iowa. • Brass Goods • Pumps • Oil Equipment • Drainage Products



SULLIVAN, ILL.
ENGINEERS: GEORGE L. SODEMANN & ASSOC.

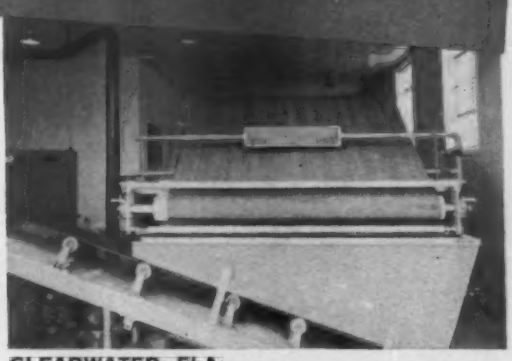
COILFILTER

AMERICA'S MOST WIDELY USED SEWAGE SLUDGE VACUUM FILTER

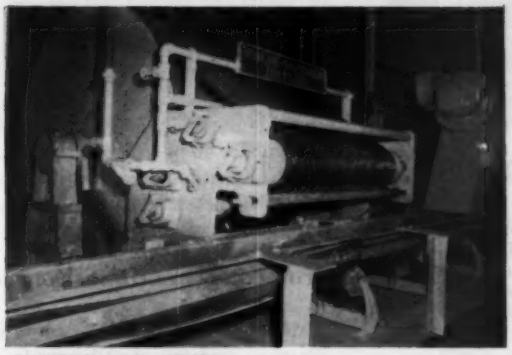
For dewatering fresh solids or digested sludge, communities everywhere are finding the Coilfilter the finest sewage sludge vacuum filter — providing rugged dependability, ease of operation, uniform high production rates and low chemical consumption.

WRITE FOR THE LIST OF COILFILTER INSTALLATIONS. BULLETIN NO. 109.

ELDORADO, KAN.
ENGINEERS: BLACK & VEATCH

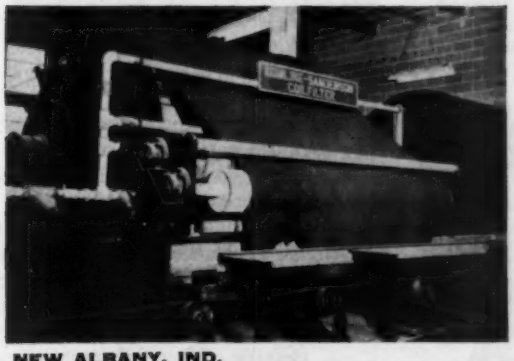


CLEARWATER, FLA.
ENGINEERS: BRILEY, WILD & ASSOC.



JONESBORO, ARK.
ENGINEERS: BURNS & McDONNELL

ALLIANCE, OHIO
ENGINEERS: FLOYD G. BROWNE & ASSOC.



NEW ALBANY, IND.
ENGINEERS: CONSOER, TOWNSEND & ASSOC.

OGALLALA, NEB.
ENGINEERS: NOSKY & HICKEY

KOMLINE-SANDERSON ENGINEERING CORPORATION
PEAPACK, NEW JERSEY • BRAMPTON, ONTARIO, CANADA

CONTINUED FROM PAGE 82A

News Bulletins

nical catalog, giving complete specifications on twenty-one special-purpose mercury switches.

The new catalog is completely illustrated, showing all twenty-one mercury switches, as well as a variety of terminals and mounting clips designed for use with the mercury switches. In addition to the operation specifications, the catalog also includes a chart showing approximate locked rotor current rating for electric motors.

Sludge Collectors

815

Yeomans Brothers Company, Melrose Park, Ill., have itemized and described their dual line of "normal duty" and "heavy duty" Streamline Sludge Collectors in a bulletin recently issued.

Details on the application of these two lines of sludge collectors will be helpful to engineers who are designing for either sewage treatment plants or industrial waste installation. Sectional drawings show typical layouts for primary and final settling tanks. Technical specifications are detailed and complete. Information plus drawings are included on modifications required to convert these sludge collectors into cross collectors for multiple tanks, and to mechanical skimmers for industrial wastes.

Computer Control and Common Sense

816

Beckman Scientific and Process Instruments Division, Fullerton, Calif., has published a 28-page booklet entitled, "A Return to Sanity in Computer Control", which attempts to eliminate the confusion surrounding the subject of process computer control. Written in layman's language, the booklet provides answers to some common problems of computer control and gives details on a step-by-step method for developing a highly reliable computer control system with a minimum capital commitment.

The booklet takes the reader from the initial feasibility study stage, through the individually justified intermediate steps, to the completion of a fully automated control system composed of standard building-block components.

Protective Coatings Booklet

817

Allied Chemical Corporation's Plastics and Coal Chemicals Division, New York, N. Y., has just published a new, 13-page illustrated booklet describing its complete line of Coal-Tar Protective Coatings. Primarily moisture barriers and impervious corrosion proofers, the coatings are particularly suitable for application on buried or immersed steel and concrete structures.

The booklet lists detailed specifications, resistance properties and typical uses for Allied's expanded cold-applied Cold-Tar Coatings line, formerly marketed under the name Barrett.

Because of their inherent resistance to water penetration, chemicals and stress condition, these coatings find wide use in a variety of industrial, utility and municipal installations.

CONTINUED ON PAGE 86A

The "3-Ms" in M&H Products

There are 3 Ms in M & H production operations which explains to some extent the wide popularity and increasing sales of M & H valves, hydrants and accessories. The 3 Ms are Men, Machines and Materials. They are the foundation of the superior design, rugged strength and high quality which users of M & H valves and hydrants have so widely recognized.

It requires all three in combination to produce a product which meets M & H standards. M & H foundry raw materials (pig iron, molding sand, everything) and the finished castings (cast iron or bronze) meet latest engineering standards. M & H foundry and machine shop both have efficient, modern equipment. Far more important than either of the foregoing, M & H workmen are craftsmen—skilled in their respective jobs, proud of their work, loyal to their Company and as much interested in making a good valve as is the boss in the office!

So, an M & H customer gets more than just a valve. He gets quality control of materials. He gets improved fabrication by modern machinery. He gets the skillful work of craftsmen who are proud of their job.

These are the 3 Ms which have placed M & H products in the forefront of the American valve and hydrant industry.

(No. 3 of a Series)

M&H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA
SUBSIDIARY OF WALWORTH

Photo above shows how easy it is to apply the Christy contour gasket around on ALOXITE porous plate . . . forming tight joints between plates, as in insert.

Contour gasket forms positive seal between ALOXITE® plates—without cement

A new, simplified method of installation adds a further "plus" to the many advantages of ALOXITE aluminum oxide plates for rapid filter bottom construction. The method utilizes a synthetic contour gasket, easily fitted around each plate. A bead in the gasket insures tight joints continuously.

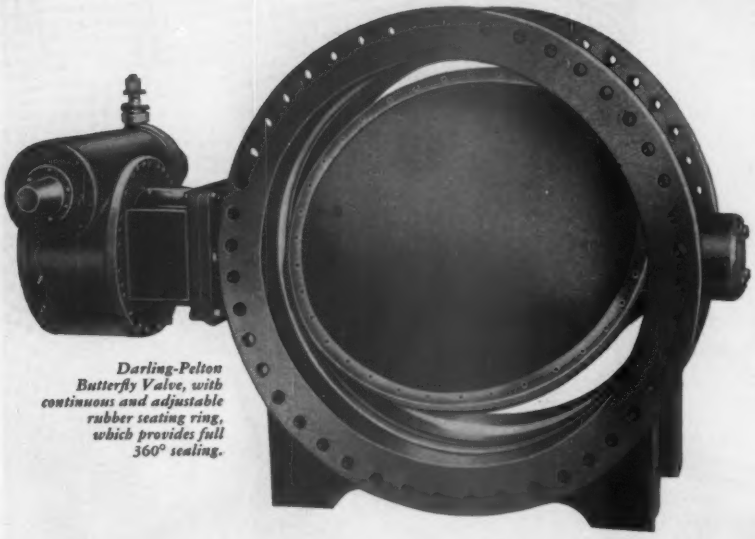
By eliminating jointing with cement or asphaltic compounds, installation time is greatly reduced. Effective sealing no longer depends on care in applying cement or attention to temperature and consistency. Pores cannot be clogged, as sometimes happens, by cement slopping over on the plates. When necessary, individual plates can be readily removed or replaced without breakage or damage to the rest of the bottom.

These contour gaskets are sold for about 50¢ each by Christy Firebrick Company, 506 Olive Street, St. Louis 1, Missouri. They are available from stock.

For information on ALOXITE porous underdrains, write Dept. X-80, Refractories Div., The Carborundum Co., Perth Amboy, N. J.

For time-tested porous media, count on . . .

CARBORUNDUM®



Darling-Pelton Butterfly Valve, with continuous and adjustable rubber seating ring, which provides full 360° sealing.

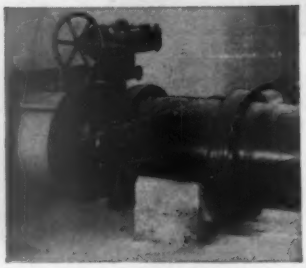
Surer sealing...easier maintenance

with **DARLING-PELTON BUTTERFLY VALVES**

Darling-Pelton Rubber Seated Butterfly Valves are designed to give bubble-tight shut-off, easy operation and trouble-free service throughout the life of the valve. The sealing member is a continuous resilient ring displaced from the operating shaft... and fully adjustable to give bubble-tight closure around the circumference of the disc.

These high-performance valves are designed in accordance with A.W.W.A. specifications...for hydrostatic operating pressures up to 125 psi and velocities up to 16 feet per second. In addition to water service, they have been successfully used on vacuum, gas and chemical service.

To get *all* the facts, write us for Bulletin No. 5904.



Close-up view of installation in large municipal water plant.

View of Darling-Pelton Butterfly Valves installed in Pittsburgh's new filtration plant.

DARLING VALVES

DARLING VALVE & MANUFACTURING CO.

Williamsport 11, Pa.

Manufactured in Canada by Canada Valve & Hydrant Co., Ltd., Brantford 7, Ontario

News Bulletins

CONTINUED FROM PAGE 84A

Welded Steel Water Pipe Manual

818

Consolidated Western Steel Division, United States Steel Corp., Los Angeles, Calif., has published a 106-page compilation of technical information entitled, "Welded Steel Water Pipe Manual."

The publication covers the background and various applications of this type of water pipe, compares its features with those of other types, and comprehensively treats the various design standards regarding such technical aspects as hydraulics, pipe diameter, plate thickness, joints, pipe supports, corrosion data, water hammer and flow coefficients.

A section alone contains numerous charts illustrating the technical data of these problems, and another section contains technical tables covering steel pipe properties, standards and other pertinent matters. Also included in the manual are on-the-job photographs of important steel pipe installations.

Automatic Water Analyzers

819

Hach Company, Ames, Iowa, has published a 32-page bulletin that discusses in detail the company's line of continuous colorimetric analyzers, continuous titrametric analyzers, continuous turbidity analyzers and portable photoelectric colorimeters.

These units are used for the continuous reading and recording of water for alkalinity, chlorine, flouride, hardness, pH, silica and turbidity. The bulletin describes the operation and construction of the units and provides pictures of the various models.

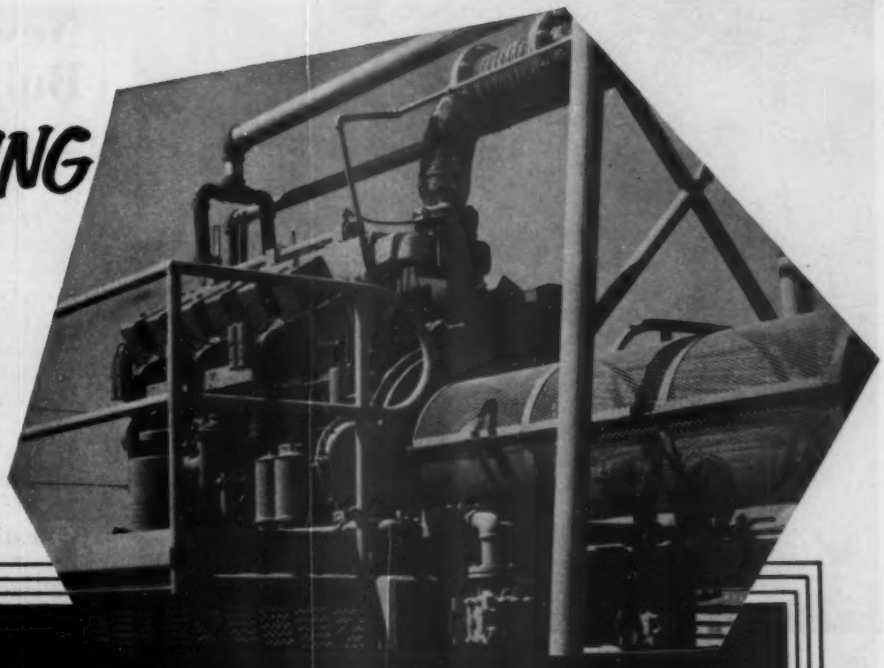
Specifications Guide for Vibration Control

820

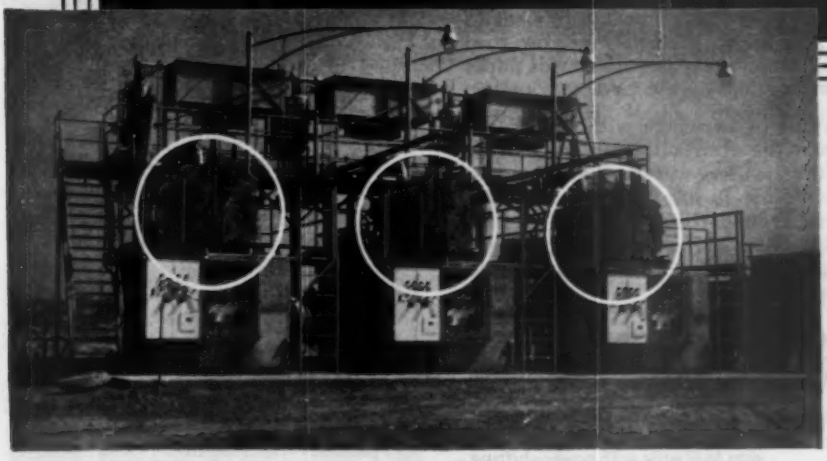
Korfund Co., Inc., Long Island City, N. Y., has published and made available a guide for writing vibration and noise control specifications for such equipment as pumps, turbines, pipe supports, compressors,

CONTINUED ON PAGE 88A

PROTECTING
outfall
basin
fluid
level



three CLIMAX V-122 ENGINES
power outfall booster pumps



At Orange County, California, Sanitation District, Plant 2, three Johnson vertical flow centrifugal type outfall booster pumps are powered by three V-122 Climax 3232 cu. in. engines: 12-cyl., 60° V-type, 7" bore x 7" stroke. Engines are equipped with ebullient cooling, full automatic starting and speed regulation; burn sludge gas, with natural gas for standby, and drive through Western BSV-144 right angle gears, ratio 2.1304:1.

In the Orange County treatment plant, ordinarily the treated sewage flows by gravity from the plant through a 3000 ft. long outfall conduit to the ocean. But an increased inflow to the plant, or a high tide, or a combination of both, causes the outfall forebay fluid level to rise. At a predetermined point Pump Unit No. 1 starts, warms up, then goes on the line. Further increases in fluid level bring Pump Units No. 2 and No. 3 into action, when necessary. The three Climax Engine powered Pump Units can handle maximum flow at the highest tide, and then some. With a decrease in outfall forebay level, the operation reverses—the units dropping off as need diminishes. For sewage treatment plants—seven rugged Climax Engine models . . . 12, 8, and 6 cylinders, burning sludge gas, or capable of operation on natural gas, butane, gasoline, or any combination . . . ranging from 100 hp to over 600 hp. Write for engine bulletins.

CL-118

CLIMAX ENGINE MANUFACTURING CO. • DIVISION OF WAUKESHA MOTOR COMPANY
FACTORY—CLINTON, IOWA

INSTANT LATERAL DIGGING WHEEL SHIFT LICKS TIGHT-QUARTERS TRENCHING JOB

THE CLEVELAND JS-30 TRENCHER, with instant lateral shifting and power tilting of its digging wheel, got high daily trench production for McShane Contracting Co. of Pittsburgh on a water line job that would have slowed an ordinary trencher to a snail's pace. The trench had to be dug in an extremely narrow road shoulder hemmed in by poles, trees and heavy growth on side slopes rising sharply within less than six feet of the pavement's edge.

Able to dig behind either crawler or anywhere within its 6-foot width, the JS-30 easily dug past the obstructions in the narrow shoulder. Lateral position of the crawlers was changed as necessary to get by obstructions, while the JS-30's digging wheel was power-shifted laterally, keeping trench digging right on line. Power-tilting of its digging wheel allowed the JS-30 to dig straight vertical trench with one track higher than the other on the side slopes, without blocking or cribbing.

THE JS-30—A TRENCHER OF AMAZING UTILITY

- Digging wheel power-shifts 5' from side to side
- Digs trench flush with parallel pavement, curbs, etc.
- Digs trench virtually flush with trees, poles, fences, etc.
- Digs vertical trench on side slopes, cuts blocking, cribbing
- Excavates bell holes, saves on trench width
- Digs 11"-24" wide, to 5½' deep; digs to 6' wide with power-shifting of wheel
- 100% control of all operations at operator seat.

Get the complete story on the JS-30 from your distributor

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Good Everywhere ®

New Bulletins

CONTINUED FROM PAGE 86A

fans, and air conditioning units.

The 6-page guide discusses the factors involved in the selection of the various resilient mountings commercially available, with particular attention given to the effects of existing location conditions; specifically, extremely critical, critical and non-critical conditions. It is illustrated with 14 pictures which show the exact type of vibration control mounting to use for each problem.

Indicating Bellows Meter

821

Minneapolis-Honeywell Regulator Co., Industrial Division, Philadelphia, Pa., is offering a new specification sheet that describes an indicating bellows meter which combines the characteristics of the mercuryless bellows meter body with a durable, easy-to-read, 6 in. dial indicator.

The unit is pictured, and pertinent technical information is provided by means of dimensional diagrams and performance charts.

Storage Tank Advertisements

822

Chicago Bridge & Iron Co., Chicago, Ill., has announced the publication of "Tanks That Advertise", a 4-page brocure describing special elevated water storage tanks built as king-sized replicas of consumer products.

The new brochure is illustrated with photographs of eye-catching steel structures which combine efficient water storage and sales promotion for a number of leading companies, manufacturers and utilities alike.

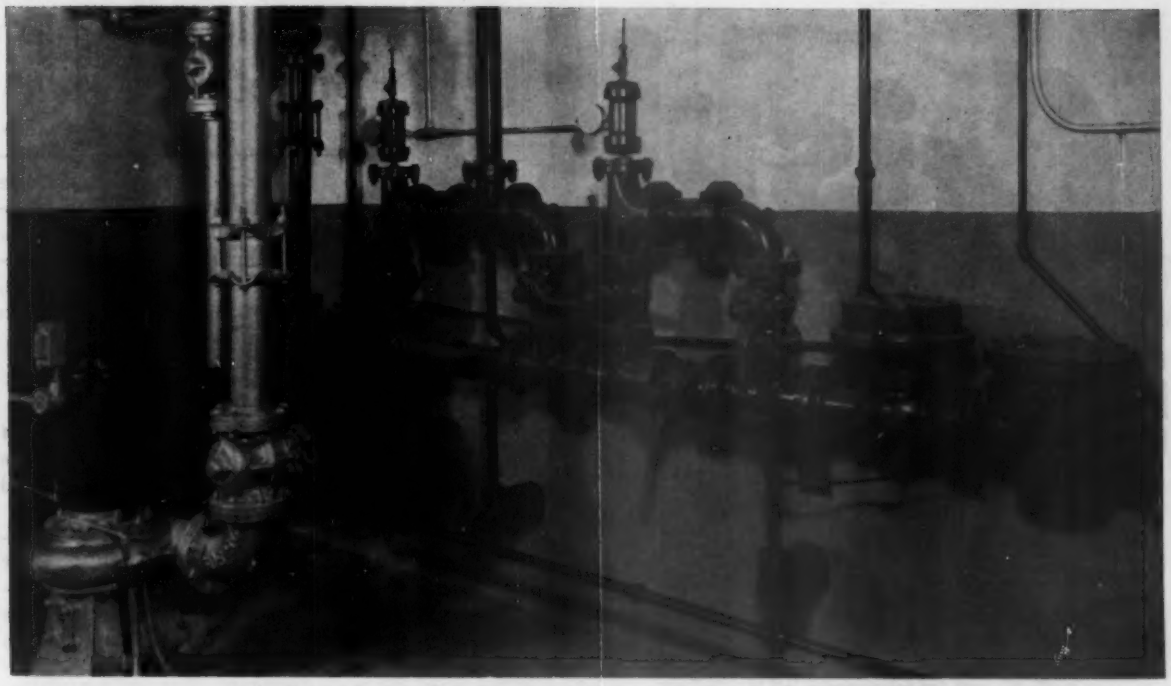
Short Form Catalog on Electro-Mechanical Components

823

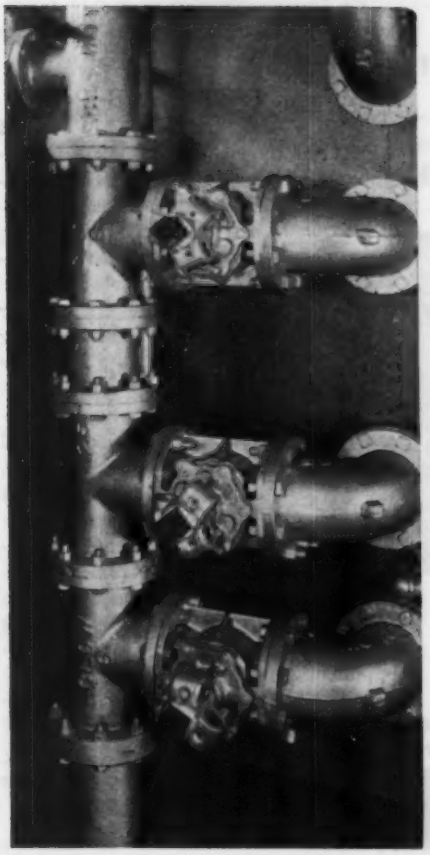
Schaevitz Engineering, Pennsauken, N. J., has announced the publication of a short form catalog on electro-mechanical components.

The 4-page, illustrated brochure, covers the company's principal lines

CONTINUED ON PAGE 90A



DeZURIK VALVES . . . TOP CHOICE of PRIVATE UTILITIES, TOO!



This unique sewage treatment plant is owned and operated by Huber Utilities of Dayton, Ohio. (Consulting Engineer, Ralph L. Woolpert & Associates of Dayton; Prime Contractor, Christopher Construction Co., Columbus.) The plant is NOT unique in the selection of DeZurik Valves; many sewage treatment plants have made DeZurik Valves first choice. It IS unique in being a privately owned facility built to serve a large housing development by the Huber Company.

The DeZurik Valves pictured above are on gas lines from the digestor; those pictured on the left are supernatant draw-off valves, used to draw supernatant from the primary digestion tank.

DeZurik Valves . . . installed in your plant . . . can give you the same ease of operation, tight shut off and long life they are providing in Huber Utilities. They operate easily because the plug touches the valve body ONLY in the closed position. They close dead-tight WITHOUT LUBRICATION—on gas OR sludge—because of their resilient-faced plug. They give longer life because of their nickel seat.

For more information, consult the DeZurik representative in your area, or write to

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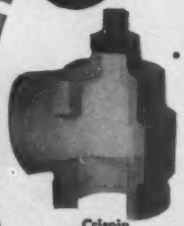
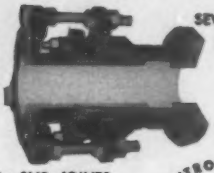


Crispin DEEP WELL AIR VALVES adjustable screw top attached to Crispin Air & Vacuum Valves controls air flow to eliminate damaging float flutter.



Crispin SEWER AIR VALVES automatic, not manual, control of air in equipment used for the treatment and disposal of sewage.

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New Bulletins

CONTINUED FROM PAGE 88A

of LVDT'S, RVDT'S, Transducers and Accelerometers for use in measuring, indication, recording and control applications. In addition to mechanical and electrical specification, the brochure also includes application diagrams and performance curves.

Hidden Water Costs is Theme Of Bulletin

824

Leslie Co., Lyndhurst, N. J., has completed a new bulletin on liquid pressure reducing valves.

The new bulletin entitled, "Eliminate Water Waste With Controller Pressure", points out ways that proper valve selection and application can reduce "hidden costs" connected with the use of water in industry and focuses attention on the pitfalls in allowing water pressures to go unregulated or poorly regulated.

In addition, the new bulletin describes in detail how water reducing valves operate and gives complete information on proper sizing procedures. Pertinent diagrams and charts are included.

Sewage Treatment Bulletin

825

The Conveyor and Process Equipment Division, Chain Belt Co., Milwaukee, Wis., has announced the publication of a 6-page bulletin covering its new circular scraper sludge collector.

The bulletin introduces the circular scraper collector and scum remover that is the first model of a new line of scraper and skimmer mechanisms designed to meet specific requirements of municipal and industrial treatment plants. It outlines design, installation, and operating advantages and contains detailed cross-section drawings of a typical scraper mechanism. In addition, it presents exploded illustrations of the new scum collector, drive assembly, skimming device and typical truss section components.

The company's new circular scraper sludge collector is the result of extensive research toward meeting specific needs in the water, sewage and waste treatment fields.

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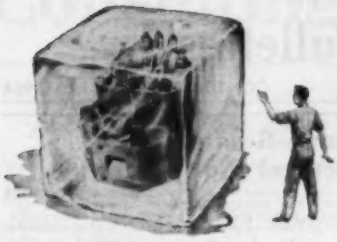

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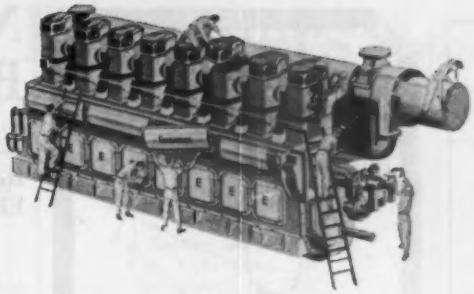

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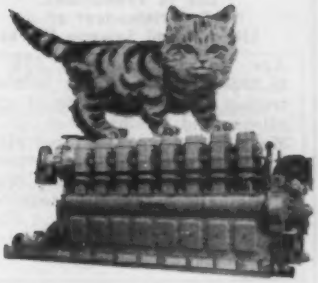

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of Mill Creek Sewage Works

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Applications must be filed on or before September 2, 1960. Send complete resume to

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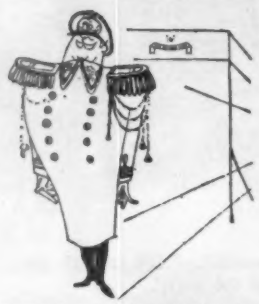

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New Bulletins

CONTINUED FROM PAGE 90A

Remote-Reading, Electrical Flow Meters

826

Republic Flow Meters Co., subsidiary of Rockwell Manufacturing Co., Chicago, Ill., has issued a new bulletin that describes its remote-reading, electrical flow meters suitable for all types of liquids and gases at line pressures to 5000 psi.

The company's complete line of electrical remote-reading flow meters for steam, water, oil, and special liquids are illustrated. Principles and engineering features are described, including typical electrical circuits, flow charts, piping and boiler arrangements and piping requirements for orifices, flow nozzles and venturi tubes.

Pressure Regulator Catalog

827

OPW-Jordan Corp., Cincinnati, Ohio, has published its new 8-page catalog that gives up-to-date information on the company's line of Sliding Gate Pressure Regulators which are designed for use on steam, water, air, oil, gas or corrosive chemicals.

The catalog describes the applications of each of the four basic types of Regulators and how each type works. The self-cleaning, self-lapping action of the Sliding Gate seat is clearly illustrated, and the booklet also explains how sliding gate construction gives straight through flow. The catalog features cutaway drawings, sizing charts, flow curve, sample specifications and complete engineering information.

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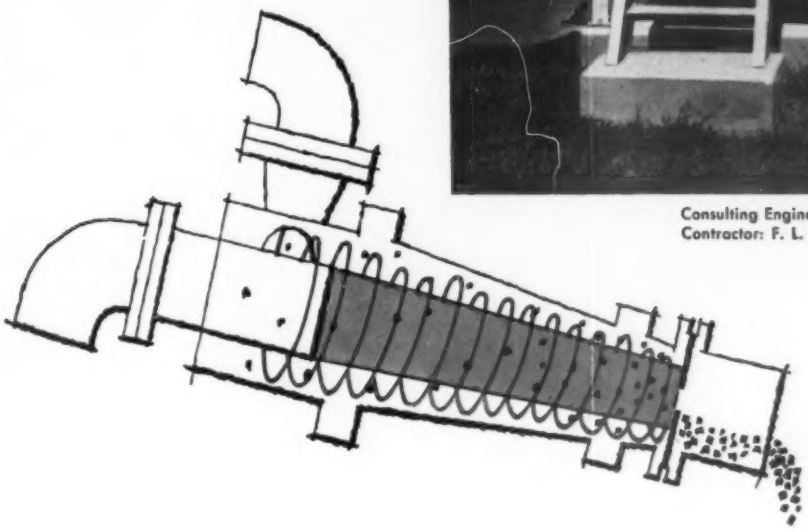

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